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ARTIFICIAL METHODS OF PROPAGATING GAME BIRDS

By AUGUST BADE, Superintendent of State Game Farms

THE MORE WE DELVE into this interesting subject of artificial incubation and brooding and become familiar with its possibilities, the more we are convinced that the system has come to stay and game birds of the future will be produced via the incubator and brooder. Quite naturally there are a few minor details to be worked

out, but practical breeders of the present day are well agreed on fundamentals. The adjustments that will be needed will be more in the nature of changes to suit local conditions.

Brooding practices will hold quite true in all localities but the incubator presents troublesome details that will test the patience and ingenuity of the operator. We should not be discouraged for history tells us that the orientals are past masters with artificial incubation although their equipment is very primitive.

One traveler relates this interesting story. While visiting in the Hawaiian Islands he witnessed three Chinamen taking off a hatch of 14,000 ducks. For incubators they used holes dug in the bank of a rice paddy and common manure furnished the heat. Each hole or incubator contained about 100 eggs and about 90 per cent of the eggs produced ducklings. Surely if a Chinaman can secure such good results with primitive equipment we ought to be able to do equally as well with the fine equipment at our disposal at the present time.

Modern engineers have given us positive heating elements in gas, oil, and electricity, as well as ventilating systems that change the air in a machine as often as desired. In addition to heating and ventilating systems, our modern machines are equipped with moisture devices that will meet the incubating requirements of any kind of egg under any climatic conditions.

Experience has shown that chicks properly hatched are easy to brood, so the time to start getting results from your brooder is in the incubator. The best of brooding equipment, the choicest feeds, and the best of care will not make good poults from poorly hatched chicks. It is not enough to get the chicks out of the shell, but rather the important thing is the way they get out. Many chicks develop within a day or two of the hatching time and then die. Some even pip the shell and can't get out. These facts are indicative of poor incubation.

Generally speaking heat, moisture, and ventilation are the chief factors in incubation. Or putting it in another way, and possibly the correct way, it is the proper combination of these three factors that produces fine healthy chicks. Modern engineers have given us positive and dependable heating units in electricity, gas, and oil, so that we know we can maintain an even temperature in any kind of an incubator. At the same time ventilating systems have been tried and proven so it is possible to change the air in a room or incubator as often as desired. A power driven fan is usually employed for this purpose. Incubators using this system of ventilation are called forced draft machines. The Buckeye, Jamesway, Lincoln, Robbins, and Petersime are representative types.

Then there is another kind of incubator in which air circulation depends entirely upon the principle that warm air, being lighter, will be replaced by cold air, and in that way the machine is ventilated. This type of machine is called a flat top. The Charters (now Wood Bros.), the Petaluma, Prairie Queen, and J. W. Miller machines are typical types of the flat tops.

Probably the greatest factor in good incubation is a well ventilated and arranged incubator room. The best of machines placed in poorly ventilated rooms will give mediocre results. A basement, an outbuilding, or unoccupied room is often pressed into service as an incubator

room with poor results. Many times the particular type of machine used is blamed for the results when as a matter of fact the fault lies entirely with room conditions.

Since the incubator must breathe or take up the air in the room, it is easily seen that if the room is not supplied with fresh air the incubator will suffer. We are all familiar with the results of having slept in a poorly ventilated room. After an egg begins to incubate and the germ develops it throws off carbon dioxide just as we do in breathing. If the room does not afford clean, fresh air in sufficient quantities to produce and sustain life, the eggs will not hatch well, and what few do hatch are liable to be short lived.

The first requisite then in any program of artificial incubation is a well ventilated room. In addition to being well ventilated all draughts should be avoided and the air admitted so it will be gradually warmed as it enters the room. If this is done it will be much easier to keep the room at an even temperature, which is a second requisite for the proper operation of an incubator. If the room temperature shows too much of a variation it will be hard to keep the machine at the proper temperature. So far as possible the room temperature should be kept at about 78 and then it will be found much easier to control moisture conditions in the incubator.

Most of the late model machines have ample moisture facilities so with the aid of the hygrometer it may be known exactly what moisture content is present in the machine at all times. The hygrometer is just as much a part of the equipment of a good incubator as the thermometer is in reading the temperature in the machine.

If a forced draft machine is being used it should be set for a temperature reading of 99, and the machine let run for a day at least to be sure it is holding this temperature. For the first week the hygrometer should read 70 and this reading may be increased five points each week.

After the first hatch is off it is possible to check more closely on the moisture content according to how the eggs hatch. A good way to judge the moisture is by the development of the air cell in the egg. This can be done very well by setting a hen at the same time the incubator is started and compare the eggs as the process of incubation proceeds.

The hen should be set on the ground with just enough of nest litter to protect the eggs from coming in contact with the soil. If conditions are right the air cell at hatching time will occupy about two-fifths of the length of the egg. The development of the air cell should be gradual and if the air cell in the incubator eggs is not developing as fast as the eggs under the hen then cut down on the moisture in the machine. The common egg tester may be used in examining the air cell. If this instrument is not available a common flashlight and cardboard with a small hole in it may be used.

At the end of eight days it is well to test all eggs so the infertile ones may be discarded. Under the light of the egg tester the infertile eggs will show white and the fertile ones will show blood veins and the form of the chick. As the incubating period advances fertile eggs will become darker and the only light spot on the egg will be the air cell at the large end of the egg.

If a forced draft machine is used it is not necessary to air the eggs as is the common custom. There may be some justification for this procedure with the flat top, although it is a debatable question among hatcherymen. But the turning of eggs at regular intervals is very important. They should be turned at least twice daily and four times during the twenty-four hours if it can be done. If eggs are not turned, crippled chicks will be the direct result.

When the flat top type of incubator is used the temperature reading is different. Experiments with this type of machine show that the best results are had when the temperature is held between 101 and 103. In taking this temperature reading care should be taken to always have the bulb of the thermometer in the same relative position, which should be the center of the egg. It must be remembered that the heat in a flat top machine drops rapidly as the bottom of the incubating chamber is approached. This test taken with a thermometer will convince anyone of the necessity for always taking the temperature at a given point.

The following table of temperatures and relative humidity will aid the operation of flat top machines in hatching game bird eggs:

<i>Time</i>	<i>Temperature</i>	<i>Relative humidity</i>
First eight days	101 to 101½ F.	45
Second eight days	101 to 101½ F.	45
Last eight days	101½ to 103 F.	45 to 55

DRY DOWN OR EVAPORATION DURING INCUBATION

As the period of incubation advances eggs become lighter in weight and experiments have shown that the best results are had when this evaporation takes place according to the following table:

The first eight days will show a loss of 4 per cent in actual weight.

The next eight days will show a total loss of 9 per cent in actual weight.

The last eight days will show a total loss of 13 per cent in actual weight.

If one cares to check this closely the tray can be weighed when empty, and then weighed when full of eggs, and the difference in weight at the end of each period noted.

Present day incubators are made as near fool proof as possible with automatic controls and thermostats, but there is always a place for the personal element and the ingenious operator will always get added returns for his care and painstaking attention to details.

Seldom are two places found identical in climatic conditions so it is useless to lay down hard and fast rules and say that they will at all times give good results. The safer way is to master the fundamentals of artificial incubation, study local factors, and adjust your machine to meet the requirements. A record of outside temperatures night and day, average room temperature, and a complete record of the machine, will generally help the operator to solve local problems. And if these records are not kept accurately they will be of little value. If there is a local hatcheryman in the locality who is successful, he should be consulted as he may be familiar with local conditions and in a position to give real help.

THE ARTIFICIAL BROODER

Brooders, like incubators, are of many types and designs, some good, and others not so efficient. Here again we have gas, oil, and electricity for developing the necessary heat. However, since electricity is in general use and widely distributed we will deal particularly with this type of brooder. Electric brooders in the main are of two types, the hot air and the radiant type. We will not go into details on the merits of the two only to remark in passing that in the past few years the radiant type has grown into general use and is possibly operated with less attention to details.

If the brooder room is well ventilated, and it should be, ventilation is of no concern, except as it applies to draughts, when the radiant type of brooder is used. If the hot air brooder is used, attention must be given to its ventilation in order to get good results.

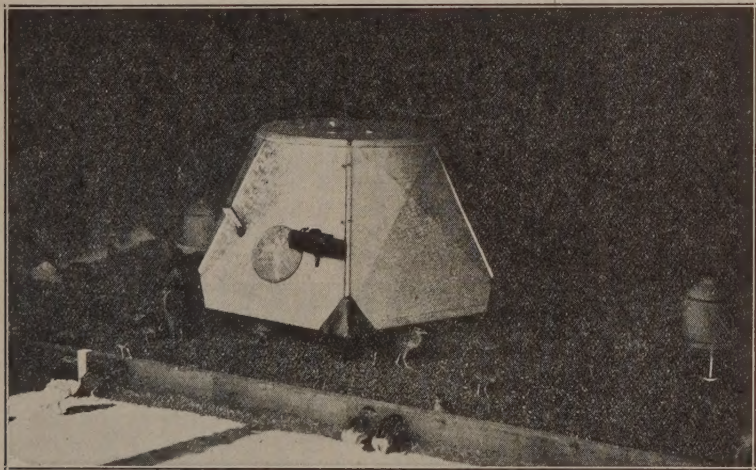


Fig. 16. RADIANT TYPE ELECTRIC HOVER.—The 250-chick size hover, 110 volts, 500 watts, will take care of 100 pheasants or birds of that type for a period of 35 days. This equipment works very nicely in an 8 x 12-foot room with a 6 x 12-foot run.

In the study of artificial incubation we were concerned with but three factors, heat, ventilation, and moisture. In brooding we are only interested in heat and ventilation. As was pointed out under incubation the first step in successful brooding is a well hatched chick. The next consideration is the kind of equipment, and the third is a balanced feed ration.

The particular type of brooder is not so essential but it must have positiveness so it will maintain the proper heat at all times and under all circumstances, with ventilating facilities, either in the brooder, or through the room ventilation, so that a uniform temperature may be had at all times of the day and night. Of all the brooding ills chilling is positively the worst as it leads to many other incurable

troubles. In the selection of the brooder it should be made certain that it is equipped with a thermostat and ample heating units so it will be able to keep the temperature at an even level, day and night.

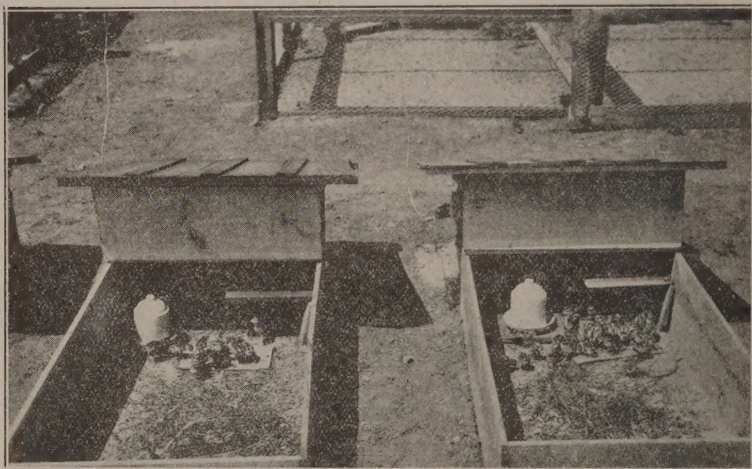


Fig. 17. SMALL INDIVIDUAL BROODERS.—For the person who desires to raise but a few broods of birds this equipment is ideal. The hover will fit into the average field coop and the heating elements develop about 150 watts.

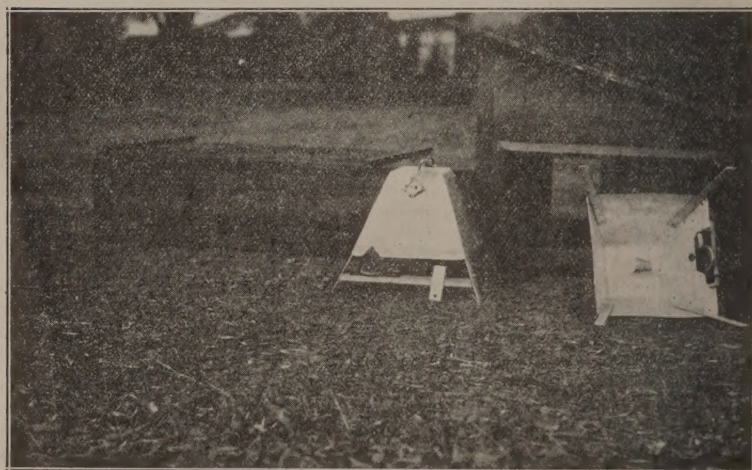


Fig. 18. CONSTRUCTION OF SMALL BROODER.—These small brooders are made either square or round. The square type here shown is 14 inches across the base and 6 inches at top. Height of side is 10 inches and length of legs 4 inches.

There are many types of thermostats in use and like incubators and brooders they vary in dependability. The cheap type of thermostat very often proves costly in the end. Care should be taken to get the

best when buying a thermostat, and then it should be tested before chicks are put in the brooder.

BROODING TEMPERATURE

The nursery chamber of the incubator, if the flat top type is used, will be about 98 degrees, so it is well to start chicks in the brooder very close to this temperature in order that there will be no quick change to cause chilling. In the handling of the chicks from the incubator care should be taken to avoid chilling. Do not remove the chicks from the incubator till they are dry and fluffy. If they remain in the nursery tray of the incubator for twenty-four hours after hatching better results will be had than if they are removed sooner.

If there are enough chicks for two brooders it is well to grade them as they are taken out of the incubator, placing the strong lively ones together and the slower moving chicks in the second brooder. At the end of three or four days there may be little difference in them but the first few days in the brooder may make a lot of difference where strong and weak birds are placed together.

SIZE OF BROODERS AND BROODER ROOMS

Game birds can not be crowded in a brooder to the extent that domestic poultry can, and one fact to be remembered at all times is to give them ample space. Experience has proven that pheasants and birds of that type require at least 1.6 square feet of floor space per bird in order to get the best results. If large numbers of them are being brooded, a room 8 x 12 feet with a screened in run 6 x 12 feet will take care of 100 birds. For a room of this size the 250 chick size radiant type of brooder with 500 watts of heating units is used.

The brooder stove is placed in the center of the back six feet of the room and the birds are confined around the hover for the first few days by the use of a circle that can easily be made with strong building paper 18 inches high. The circle should be started about eight inches from the edge of the hover and gradually widened as the birds develop until about the end of the fifth day it will be out at least two feet from the edge of the hover and then it may be removed entirely, giving the birds the use of the entire room. If the weather is very warm they may be permitted the use of the screened in run for several hours after they are six or seven days old.

The back portion of the brooder room floor, the space 6 x 8 feet where the brooder stove sets, is covered with an inch of coarse river sand. The other half of the brooder room floor may be covered with rice hulls to the depth of an inch. This affords fine floor litter as well as providing small grit for the birds. The floor of the run in front of the brooder is covered with loam mixed with fine sand to the depth of two inches. This screened in run not only affords extra exercise space but a fine dusting place and brings the birds in contact with the direct rays of the sun. The front of the brooder house is covered with one inch mesh poultry netting in addition to having a muslin curtain that is used at night and on cold days to keep the room warm. On warm days this curtain is removed, allowing extra ventilation as well as direct sunlight to enter the room.

For convenience in keeping the room as well as the run in a sanitary condition the floor of both is made of concrete about four inches thick. The brooding period lasts about thirty days after which the birds are ready for the open rearing pens with no heat but that furnished by their well feathered bodies. The litter of the brooder room floor as well as the loam on the floor of the run is removed, disinfectant applied, and a new coating of sand, rice hulls, and loam put on, before another lot of birds are placed in the brooder house. If this procedure is followed little trouble will be experienced with any of the many ills coming from unsanitary conditions. So much then for the large brooder house and its equipment.

Many people want to raise but a few birds so we have devised a small brooder stove and equipment that will meet their needs in a very satisfactory way. This brooder stove is equipped with a small

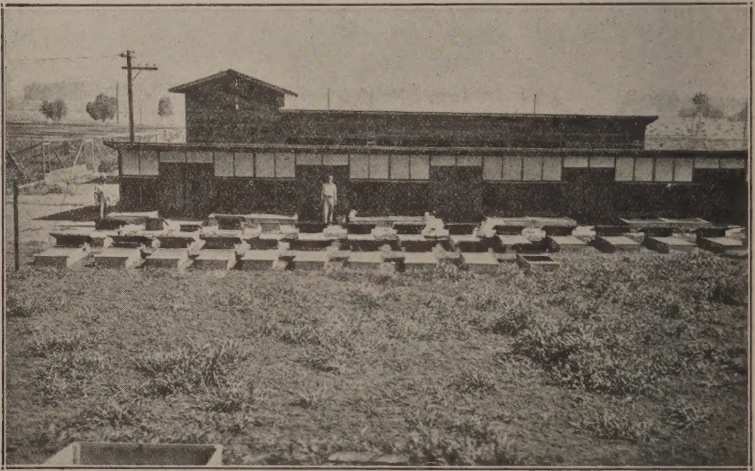


Fig. 19. SMALL BROODERS HANDLING QUAIL.—This picture was made May 22, 1931, at the Los Serranos farm. Six hundred Valley quail are being brooded in this battery of small brooders.

heating unit of about 150 watts and will take care of from 16 to 20 pheasants or partridges. These hovers are built to fit into the ordinary field coop that was formerly used when the domestic hen was the source of brooding heat. These hovers may be either square or round in construction, and are supported by four inch legs. Experiments have proven that chicks placed in this type of brooder and treated in every way as though a hen were their foster mother respond normally and naturally to this metal hen.

However, the metal hen has this advantage. She does not step on any of the young birds and is always hot and ready to brood them when they become chilly. Anyone who has attempted the raising of pheasants or quail with domestic hens will appreciate this feature of the metal hen. This is not the only advantage this type of hen has over the Buff Orpington or Rhode Island. The metal hen carries no

disease or external parasites to worry her young charges, but is clean and sanitary in every way.

If the artificial rearing of game birds had no other advantage, and it has many more than have been enumerated, the elimination of

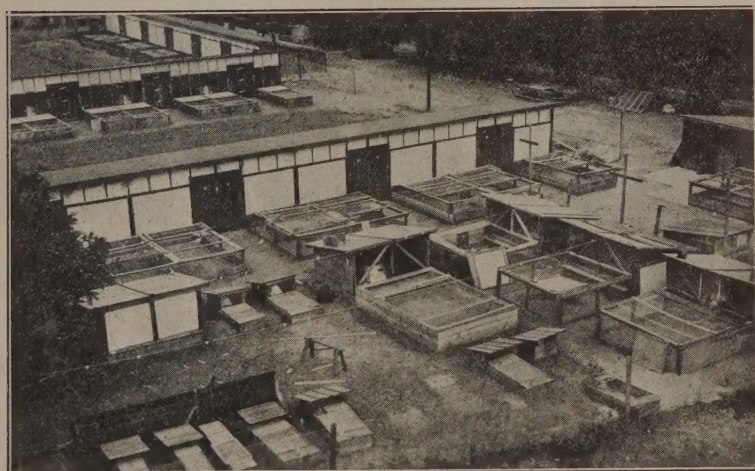
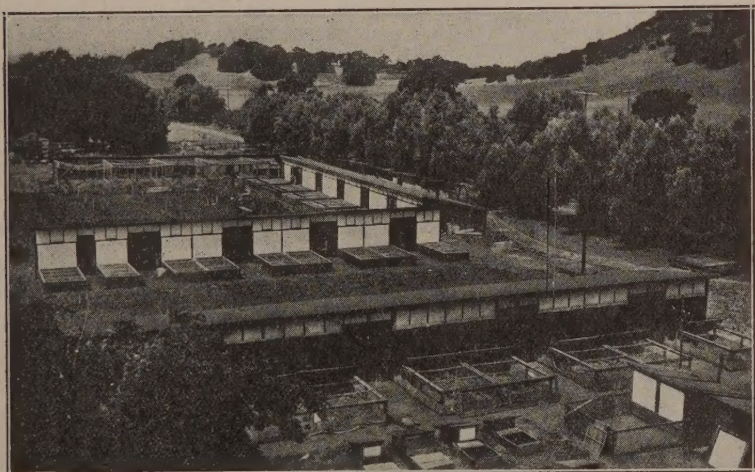


Fig. 20. BROODER HOUSES OF VARIOUS TYPES.—Here are various types of brooder houses in use at Yountville farm. Notice white muslin curtains, some in place and others laid back to give more ventilation and direct sunlight.

the disease hazard would justify its use. It has been truthfully said that this is an electric age. The average boy or girl knows more or less about electrical appliances and is familiar with the savings in labor and actual results accomplished. It is only natural then that

this type of equipment should appeal to them because it embodies the every day practices of household duties and much of the common work of the farm.

But when it comes to domesticated hens and their handling, there is an inclination to not be interested, and as a matter of actual fact how many of our younger generation understand the hen and can get along with her? Not many, I assure you, judging from experiences on our game farms. But it is different with electrical equipment. Our boys put in long hours working with the incubators and brooders and at no time do the hours seem to hang heavy. The work is interesting at all times and the results are far better than they were a few years ago when the old domestic hen held forth.

There is another advantage seldom thought of and that is a matter of actual room required, and the general working conditions. The

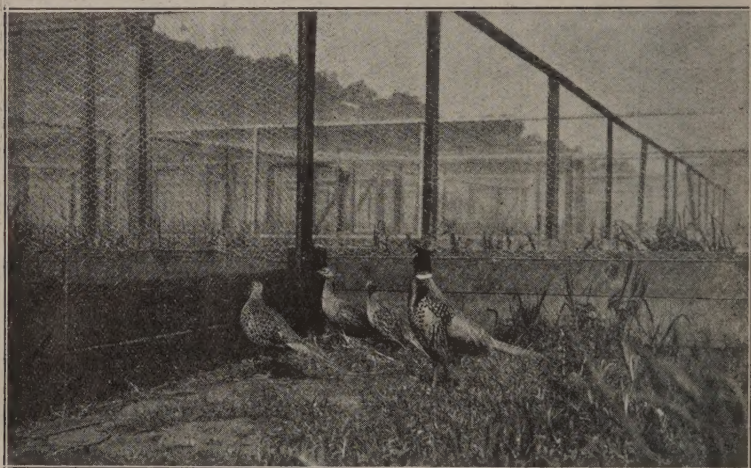


Fig. 21. The Ring Neck pheasant in breeding pen.

average back yard can be utilized for the rearing of many birds up until the time they are ready for liberation, which is about ten weeks, and the space so used, and the equipment, is easily cleaned, disinfected, and made ready for another lot of birds.

FEEDS AND FEEDING METHODS

According to experiments at both of our farms during the past three years we have secured the best results from a combination of the wet and dry systems of feeding. A dry mash that is made up of the following ingredients is kept before the young birds at all times.

DRY MASH FORMULA

25 lbs. ground yellow corn	5 lbs. dried buttermilk
25 lbs. ground barley	5 lbs bone meal
25 lbs. ground wheat	2 lbs. ground limestone
15 lbs. best fish meal	

For the first two weeks' feeding the dry mash is ground in the ordinary way, but after that a coarser grind is used as there is less waste in the feeding process.

THE WET MASH

The wet mash is made with various combinations according to the operator and his past experiences, if he has had any, but the one in most general use is as follows:

Pheasant meal, number 12-----	35%
Hard boiled egg finely grated, or egg custard-----	10%
Cottage cheese or Milko-----	10%
Crissel or fish meal-----	10%
Finely chopped greens (clover, lettuce, kale, or alfalfa)----	35%

For the first day or two it is well to feed just the grated egg with the cottage cheese or Milko, and a little of the finely cut greens. After this the regular ration may be used for the next two weeks when the amount of eggs is decreased and its place taken with more greens. By the end of the third week leave the egg out entirely, and at this time change the number 12 meal for the number 5, which is the next larger size.

HOW TO PREPARE PHEASANT MEAL

Pheasant meal is a very dry, well cooked product that requires moistening before it is ready for use in feeding. Never try to feed it dry. If this feed is not properly moistened there will be a great deal of waste in its use as the birds do not eat the dry hard particles. If prepared in the following way it is not an expensive feed to use. For every four parts of dry meal add three parts of hot milk or water and stir well until every particle comes in contact with the liquid. As soon as it is well mixed it should be allowed to stand for five minutes, and then mix it again. Go through this procedure three or four times. As the meal is worked with the hands the swelling of the particles will be noticed and the object is to get the meal fully expanded before it begins to cool.

After it is fully expanded let it set for an hour or so until it is perfectly cool before using it in the feed. It is well to mix the morning feed the night before and each following feed at least two hours before it is needed. By this is meant the preparation of the meal. The other ingredients such as cheese, crissel, greens, etc., are mixed with the meal just prior to feeding time. If a cool place is available in which to keep the meal the entire day's supply of moistened meal may be prepared at one time. If left in a warm place it will sour quickly. Avoid any kind of sour feed.

Wet mash feed is best served on boards about a foot wide. The ordinary redwood lumber a half inch thick and ten or twelve inches wide when cut into two foot lengths makes excellent feed boards. As soon as the birds are through eating, the feed boards should be leaned up against the run or side of the brooder. These boards should be kept clean at all costs. The dry mash is best fed from small metal feeders. These can be had in all desired lengths. Fill the dry mash trays about two-thirds full and less waste will be evidenced, and a saving will be effected in the amount of mash consumed. If these metal

feeders are placed on 1 x 8 boards it will be found easier to keep them clean.

Use the wet mash feed four times a day, a small amount at a time, just what the birds will clean up in about ten minutes, and at the end of two weeks cut the feed to three times daily. Continue this program until the birds are eight weeks old when two feeds a day are sufficient.

IMPORTANCE OF CLEAN WATER

The inverted crock or watering jar will give good service as these may be had in convenient sizes. Always wash them daily and know they are clean. When very young birds are first watered, do not give them cold water, but temper it to the temperature of the room. After they are older they will readily take cold water with no injurious results. Many diseases begin in and around the watering devices.



Fig. 22. Valley quail breeding pens where flock breeding is carried on with good fertility and egg production.

Always treat the watering of birds as though it were for human consumption and no trouble will be experienced from this source.

REGULAR FEEDING TIMES

Game birds are naturally regular in their feeding habits and if a regular schedule is carried out with them they will respond much better. They are early risers and the morning feed should be made about 6 o'clock, the second at 10, the third at 2, and the last feed at 5.30 or 6 in the evening. The first feed to be eliminated is the 2 o'clock feed. The next the 10 o'clock, and then the birds are eating at the same times as they do in their natural wild state. All game birds are morning and evening feeders. During the remainder of the day they are quietly resting in the cover of their habitat. Here is the clue to successful handling of birds in confinement. Always sow some kind

of cover crop in the rearing pens to afford the birds this natural protection the same as they would have in a natural state. Matured birds should be provided with the same accommodations whether in holding or breeding pens.



Fig. 23. The buildings and some of the steel rearing pens at the Los Serranos farm.



Fig. 24. For the first few days young birds are confined near the hover by the use of an 18-inch circle set to start with about six inches from the outer edge of the hover. Day by day this circle is enlarged and at the end of five days is removed entirely.

KINDS OF COVER CROP

Buckwheat has proven one of the best cover crops for the rearing of young birds. It affords cover protection as well as excellent green

food. For breeding pens, transplanted kale plants, about 24 plants to a 24-foot square pen, with oats and vetch drilled in rows 8 inches apart. Seed the oats and vetch together. In order to have breeding pens ready for the season it is necessary to start preparing them in the fall so they will be suitable for the birds about the first of March.

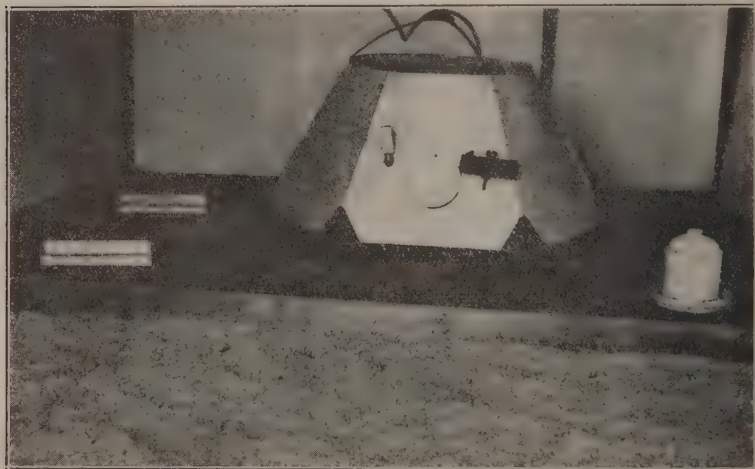


Fig. 25. Dry mash feeding trays and watering jars are placed near the hover until the birds are well acquainted with this equipment. This picture shows the division of the brooder room floor, the back part being covered with sand and the front half with rice hulls.

RATIONS FOR BREEDING STOCK

A good scratch feed and a wet and dry laying mash will prove beneficial for all kinds of game birds during the egg producing season. Use covered feeding troughs or hoppers for the dry mash and metal plates of some kind for the wet mash. The scratch feed may be fed on the ground. Pheasant meal number 5, prepared as before mentioned, 10 per cent crissel, and 25 per cent rolled oats, will give a good laying ration. The following formula affords a good dry laying mash, and should be ground coarse. Ground yellow corn 30 per cent, ground wheat 30 per cent, ground barley 15 per cent, fish meal (good grade) 12.5 per cent, dried buttermilk 5 per cent, alfalfa blossom meal 4 per cent, ground oyster shell 2.5 per cent, and ground limestone 1 per cent.

Ring Neck and Mongolian pheasants breed well in the ratio of five hens to each male with at least 64 square feet of pen room per bird. Valley quail do well when mated in the ratio of 7 males to 10 hens. Most of the partridges are strictly monogamous and seem to do better in pairs. Silver, Golden, and Amherst pheasants do better in trios. The Reeves breed well with three hens for each male with plenty of pen room.

It is not advisable to set different species of eggs under the same hen due to the different incubating dates. The following table shows the incubating period for many of the common breeds of birds usually kept in confinement either for pleasure or profit.

Ring Neck pheasant 23 to 24 days.

Mongolian pheasant 24 to 25 days.

Quail (Valley and Mountain) 22 to 23 days.

Partridges 22 to 23 days.

Silver pheasant 26 days.

Amherst and Golden pheasant 22 to 23 days.

Reeves pheasant 23 to 24 days.

Turkeys 28 to 30 days.

Guinea fowl 28 to 30 days.

Ducks 28, excepting Muscovy 33 to 35 days.

Geese 30 to 33 days.

Pigeons 17 days from time second egg is laid.

Domestic chickens 19 to 20 days for light breeds to 21 for heavy types.

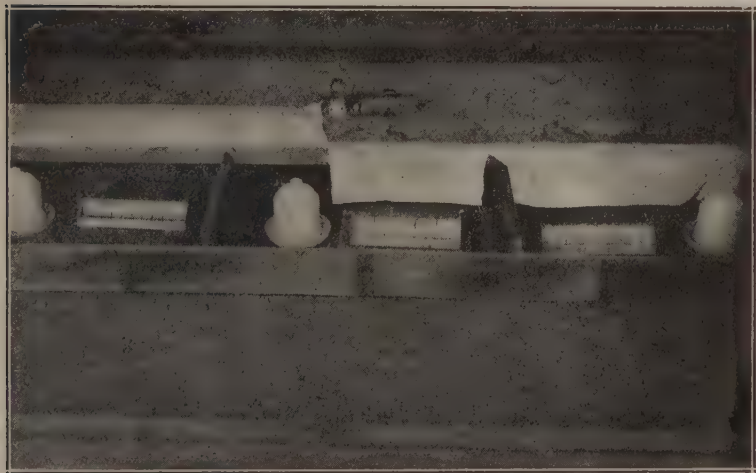


Fig. 26. Special quail brooder. This brooder, seven feet long, two feet wide, and divided by two partitions into three compartments, covers the back part of the room. The heating elements are microme wire. This heating element is similar to that used in small incubators. The brooder will accommodate 75 birds, 25 to each compartment. At the end of ten days the two partitions are removed and the birds treated as one flock. These brooder houses are eight feet square with an 8 x 12-foot run.

In such a short bulletin it is not possible to go into all the details so we have tried to call attention to the more important facts as they have impressed us in our years of experience breeding and rearing game birds. It is the hope of the author that some good may be done and the work of the amateur breeder made easier.

FIFTY-FIVE YEARS AGO ON THE McCLOUD RIVER

By EDWARD N. MOOR

FIFTY-FIVE YEARS AGO I received the answer to a long desired wish, to fish the McCloud River in northern California. I have a record of this trip in an old sketch book, with dates on the sketches that pin my memory down to June, 1876. At that time, even when all the streams within easy reach of San Francisco presented good sport for the lover of angling, the McCloud was looked upon as being the one place of all others to visit.

I recall in those days the possibilities within easy reach of this city, and the man who now passes these places in his automobile, unquestionably doubts that such could have been the case, even in horse-and-buggy days. A small rivulet that passed right through the present town of Burlingame was "fishable" in April, when the season opened, and enough could be caught for a fair mess; San Mateo Creek from San Andreas Valley right through the town and to tide water, was good; San Francisquito, and all the small streams below that to the south, would surprise one, for they were overlooked most of the time. In Napa County every rivulet that debouched into Napa Creek on both sides of the valley was well filled with trout; in fact, a trip to any of these places brought satisfactory results; a bit further away in Sonoma County, both forks of Austin Creek, Ward and Kidd creeks; the Upper Gualala; all almost untouched by outside visitors, and even the residents, farmers and stockmen, seldom indulged in the sport. It was the exception when one met another fisherman on these streams, and there were no beaten paths or footprints on the creek bed, gravel, or sands that told of a procession of fishermen being ahead of you.

There was no limit, and I do not remember a single instance wherein waste or wanton catches were made. There were always plenty left for the next fellow.

Even all these possibilities of April first paled when the McCloud came into one's thoughts, for that place was the ultimate.

The train trip to Redding, an all-day ride, and the stage from Redding north about 9 p.m., an all-night ride, brought one to Sisson's the next morning about breakfast time. It was a rough, rapid ride, thoroughbrace stages carried the mail, and they were hard riders, and all bumps worked vertically—on the passengers, and plenty. Sisson's was the starting place for the sportsmen, and they came from far and near at times to that place, seeking a good game country. Mr. Sisson kept a hostelry wherein everything could be had to go north, south, east or west. He knew the country and had about him men fully capable, and good companions as well, to give the visitor every answer to his desire to angle or hunt.

My companion, Jim ———, and self joined forces at Sisson's with two San Francisco business men off on a trip, and we four, with Jerome Fay, the guide, outfitted for a visit to the McCloud. Jerome was one of the best men I ever went out with and he had many tales

of experiences in that country. One that evidenced his standing was of a night passed on the summit of Mount Shasta with that wonderful lover of nature, John Muir; caught in a storm late in the day, they did not dare descend the mountain, and passed the night hugging the comfortable warmth of a hot spring below the summit. Mr. Muir, in his interest in all about him, could not be lured to lower levels until too late to do so with safety.

The ride to the McCloud took one through fine timber, untouched, and the road was practically a rough trail throughout. The first view of the stream came from the edge of the lava cap, above its course, and a steep grade leading down to the river at the Horseshoe Bend. A large pool, with white water at its upper end, and the same below it, was a sight thoroughly satisfying, for in it salmon and trout could be seen in quantity. A foot log crossed the rapids above, a large yellow pine tree bole; and the face of the stream just about reached its upper side.

Into camp, on a strip of land in the bight below the pool, we settled down and got into shape to stay indefinitely—until we had enough. I owned an English green-heart salmon fly rod, and as soon as possible rigged up and sought the center of the foot log at the head of the pool. It was bait fishing, with spawn, for it was accepted that when the salmon came up to spawn that was the only method to follow. I dropped my tackle downstream from the log, and almost before I had settled myself into a receptive position I had a strike and the trouble started. The manner in which that fish rammed about the pool showed that he possessed strength and determination as well. I handled him all right, and as might be imagined, full of excitement and as busy as could be, when right in the middle of the fracas one of the pair we joined with walked out on the log, rod in hand, and tried to get me to pass him my rod; he couldn't keep his hands off. Finally got him subdued (I mean the man), and about that time the salmon came upstream, passed under the foot log, and I was handling the rod on the lower side, with the fish, I should say, thirty yards upstream above me; managed to keep from snagging the log, and the next move was a downstream rush the length of the pool, into the rapid outlet of same. I gradually put on brakes, and when the line was about gone we parted company—abruptly. And the other fellow said "I told you so!" I have found—we all have—that things will crop out of humanity, when fishing and camping, in pursuit of happiness, that cause wonderment as to just how they ever entered the other fellow.

That was the last one I lost. A weak line, from salt water, was the cause, and soon corrected.

That day was enough of the salmon. Some were fresh run and in fighting shape, but many were battered and bruised from their long fight upstream. Lighter tackle and the rainbow trout kept me busy and interested from then on. Some distance below camp a small stream came into the McCloud from the west. There was an eddy caused by an out-reaching point and accessible, with good landing surroundings. I took from that spot and a reach just below, seven fish that scaled twenty-one pounds weight one afternoon—rainbow, with the exception of one Dolly Varden, six and one-quarter pounds. It was by long patient work that I finally succeeded in getting that

large fellow to hook. He had an abiding place between parallel reefs of rock with the stream bed, in about six feet of water; my first cast close to him brought him forth to within about a foot of the hook, and then a retreat into his runway where he could be plainly seen stemming the current, which was rapid, but not surface-broken. I do not remember how many times he came so far and no farther. Jim and I determined to get him if it took all day. My companion derived as much pleasure from carrying the landing net as from fishing, and he rested and took it easy, enjoying everything in his preferred way. After a number of pipe smokes, much trying, and patient waiting after these rushes that stopped short of the goal, I swatted the hook down good and hard right over him and the offense was too much for him, and a rush came that finished in firmly hooking him, carefully I worked that fellow up to the net, and it was done. That one fish was worth the trip, and he was the only Dolly Varden taken by any of us.

From the coolness of the water came what were really acrobatic trout, for not only once into the air would they go, but time after time, and no give-up until they had actually exhausted themselves with efforts to get free.

There was no one on the stream outside of our party, and no indications of others having been ahead of us. It was as virgin to the fisherman as if it had been one hundred instead of fifty-five years ago. Now I understand that all that ground is owned by individuals and covered by expensive and elaborate summer homes, and I believe a trip there would produce heartache when comparisons were made and companions thought of, in those unspoiled days of 1876.

The fish not eaten on that trip were packed in snow from Shasta's slopes and were brought to San Francisco in perfect shape, despite the length of the journey. There was absolutely no waste of a fish at any time. One hundred and forty pounds of trout were in that ice box.

We disbanded at Sisson's that year and I went back of Eddy Mountain to the west of Shasta with Jerome, after deer. As it was on the McCloud, so it was with the deer on that trip, which ended as far as sport went at Castle Lake, on the way back.

A year later, 1877, Jim and I picked two friends and we went again. We unpacked at the Horseshoe Bend in a driving rainstorm and everything was soaked before we could get under cover. Disconcerting to our two new recruits, whose camping trips had never bumped into anything like it.

After some satisfactory days there a tramp upstream with the rifle brought us to the falls and we determined to investigate the lay of the land above them. They were of such character to preclude salmon getting over them, and if fishing could be good, should be above the falls.

Looking at the map, I believe our camp to have been about where the present town of McCloud now is.

We picked our way through the timber and struck the upper river at the lower end of a long meadow above the upper falls of the river, and made camp in a grove of tamarack pines close to the stream. That

was a stream—fairly alive with fish, and the fly would no sooner land than be taken. I caught within calling distance of camp before supper fifty-six fish, and if one desired, a cast of three flies (for I tried it) would sometimes fill before you got all in. They were different in build from the rainbow, slimmer and not as large in size; just about right to make it interesting with a light outfit.

Upstream not far above camp were three distinct colonies of beaver; dams, indications of their diligent workings, all about, and it was with great interest that some time was passed in watching them. I shot one, and got him after going in up to my shoulders and stubbing my toes against his body, for I had clipped the crown of his head off as it just cleared water, swimming upstream. He sank in easy water and air bubbles showed his location. We roasted his tail, and that's as far as we got. The pelt I cured and brought home, and as well the skull with its wonderfully efficient chisels in the lower jaw.

At the head of the stream, with their dairy house built over the output of a big spring, and a barrel churn operated by a paddle wheel therein, was a camp of butter makers. They carried their operations on there where the feed was good until the advent of winter. Put up the butter in firkins and hauled it out at the end of the season.

Sisson told me afterward that he did not know of a soul that had fished that upper stretch of the river, and there was no indication of camping anywhere to be seen. One man in an hour could take more fish than we could eat in a day. Too far away to get out to anyone, and the only way was to do something else or stop fishing. We sent the team back to Sisson's and got some of those butter firkins from a barrel factory there, a supply of salt, and the large fish were split down the back and put up exactly as New England mackerel are, and each of us had plenty to take home. They were fine eating.

That was fifty-four years ago, and if anyone ever camped in an ideal spot that upper river certainly was the place. Arriving at Sisson's on the way back, the balance of the party went home. I joined a party of four and we went to Yreka, and from there north across the Klamath at Whittles Ferry, and from there into lower Oregon, and northerly to a spot called Buck Lake which could not have been very far from Ashland, Oregon; from there back, northeast of Shasta, touching the lava beds, and back to Sisson's over an old emigrant road to the north of Shasta. On this trip after passing the Klamath no one was met until we got back to that river. Through the country to Sisson's I do not believe we met half a dozen men.

We encountered a very large band of antelope north of Shasta, at least three hundred in the band. Did not hunt them. On these journeys enough venison was had to meet camp needs, no more. It would have been possible west of Sisson's in the Eddy Mountain country to kill a dozen deer a day and not half try, and the same in southern Oregon.

I hope this will convey some adequate idea as to northern California at that time.

I am the only one remaining of all those men, and fifty-five years bring changes in country, and as well to those living in it, that certainly mark time.

DAMAGE BY DEER TO CROPS IN CALIFORNIA

By GORDON H. TRUE, JR.

THE EXISTENCE of competition between wild deer and cultivated crops in California has long been recognized, but only in recent years has the problem begun to assume economic proportions. In many places, today, we hear demands for relief from those of California's agricultural frontiersmen who, on their far-flung battle line, are waging war against the depredations of the last and most

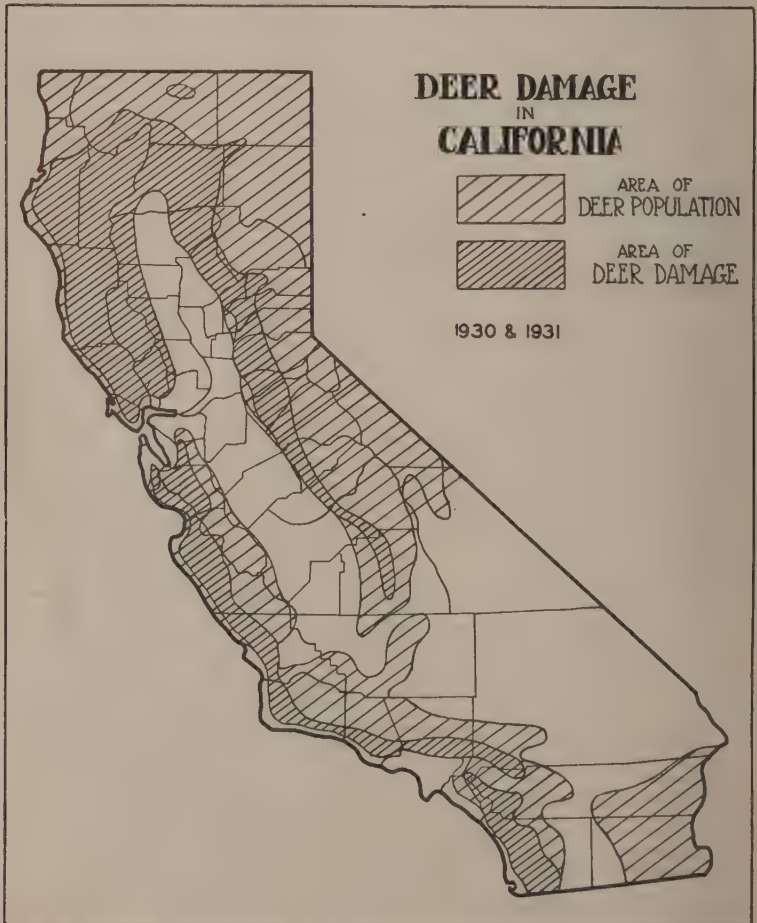


Fig. 27.

successful of our big game species—the native black and mule-tailed deer. Since it became obvious that, without protection, our deer would follow the road taken by the antelope and elk—now rare curiosities to most of us—we have bent every effort toward their conservation. They have responded nobly. In protecting deer for their esthetic and sporting value we have become involved in an economic problem with another group in the human population.

That we might better understand the deer damage problem and so arrive at its solution with less difficulty, special study of the situation was made by the Game Depredations Study Committee of the California State Chamber of Commerce in the autumn of 1930. Data were obtained through the medium of questionnaires sent out to fish



Fig. 28. West portion of vineyard near wild land with groups of vines eaten back or killed by deer. Vineyard of Guiseppe Luchesi, northwest of Yountville, Napa County, California. Photo by T. I. Storer, October 11, 1930.

and game, forest and agricultural officials and from correspondence in the files of the Division of Fish and Game and the State Chamber of Commerce. In all, two hundred and ninety-two such reports were available from fifty-one counties. The aim of this paper is to paint a picture of the deer damage situation, using as materials the mass of information obtained through the medium of this survey.*

Deer damage occurs in forty-three out of our fifty-eight counties. Those counties which have little or no difficulty are Del Norte, Lassen and Plumas to the north; Sutter, in the Sacramento Valley; San

* Special analysis of the deer damage reports was made by Dr. T. I. Storer and G. H. True, Jr.

Joaquin, Stanislaus, Merced, Kings and Kern, in the San Joaquin Valley; San Francisco and Contra Costa, in the San Francisco Bay region; Mono, Inyo and Alpine, in the southern Sierras; and, in the extreme southeastern corner, Imperial County. These counties are situated for the most part in the high mountains where there is little agriculture, exclusive of grazing, or in our great central valley, where



Fig. 29. View of gladioli which have been damaged by deer, the ends of flower stalks which have been eaten appearing as white spots. Nursery of E. D. Rodgers, Swanton, Santa Cruz County. Photo by Donald McLean, 1929.

there is no deer population. Those counties in which damage occurs include within their borders, in most cases, portions of the Coast Ranges or the Sierran foothills. Damage is often found to be localized in certain mountain valleys or in the immediate neighborhood of State and national forests and parks where deer are protected. Game Refuge 1A, in the northern part of Siskiyou County, is an example of this latter condition.

The majority of reports indicate that deer damage is seasonal in occurrence. Although in some places damage occurs throughout the year, in by far the greater number of cases the period of destruction is limited to the actual growing season of the crops affected, with special emphasis on the late summer and early autumn months. On the coast, where the deer population of a given area is relatively constant throughout the year, there is little variation in the amount of damage throughout the period during which it may occur. This is also true of the lower Sierran foothills. At middle elevations in the Sierra Nevada and in the northeastern part of the State there is a noticeable increase in damage over the normal amount during the period of migration of the deer to and from their summer and winter ranges. This has been noticed particularly in El Dorado County, where the deer damage problem has been given especial attention. Regardless of the fact that the greatest amount of damage has been reported as occurring during the latter part of the growing season, the author has observed that, at least in the coastal region, the most serious damage occurs during the early part of the summer when plants are sending

out the first tender shoots. At this time a few deer may do infinitely more damage than a larger number later in the season. It is logical to assume, however, that a greater number of deer live at the farmer's expense during that period when natural forage is scareest, turning to cultivated crops kept green by irrigation in lieu of, or as supplement to, the wild forage.

Opinion seems to be that deer damage is definitely on the increase in California. A few persons report that no change is observable or that there is a decrease in the amount of damage. The destructive



Fig. 30. Individual vine showing complete removal of leaves and some damage to berries. Vineyard of Guiseppe Luchesi, northwest of Yountville, Napa County, California. Photo by T. I. Storer, October 11, 1930.

activities of the deer seem to have actually come to a standstill or to be decreasing in only one area, Tuolumne County. This may be accounted for by the fact that the deer population of that region has not yet recovered from the reduction which occurred during the epidemic of foot and mouth disease in 1924-25, when over 22,000 deer were slaughtered in successfully preventing the further spread of that

malady. A majority of the reports from over the State indicate that the present wave of deer damage complaints is founded upon an actual increase in deer, rather than being a hysterical response to the increased attention that the problem has received.

Reports concerning the period of time over which deer damage has occurred are exceedingly variable. Several state that deer have been damaging crops ever since the beginning of agriculture. Others indicate a ten to twenty year period. In most instances damage is reported as more serious during the past one to five years.

Innumerable factors have been mentioned as the causes of deer damage. Among them are shortage of natural feed, scarcity of water on the deer range, increase in deer population, desire for succulent feed, concentration around salt-licks, planting of crops in the midst of deer inhabited areas, and a lessened wariness on the part of the deer. Several correspondents have suggested that, while the present situation is due primarily to an increase in the deer population, particularly



Fig. 31. View of orchard showing malformation of trees due to continued eating back. The branches in the foreground have been broken off by deer. El Dorado County. Photo by R. C. Berriman, February 27, 1931.

does, we must consider as an indirect cause that factor which has aided to such an extent in bringing about this increase; namely, predatory animal control. Campaigns directed toward the extermination of predatory species, principally mountain lions and coyotes, have relieved the deer population of considerable pressure. This has resulted in an almost startling increase in the deer population of some areas. We have only to look back at the Kaibab situation in order to realize that such an assertion may not be entirely without foundation. However, the deer damage problem can not be attributed to any one factor. Granting that our deer population has increased, that increase, plus any one or any combination of other factors, would be enough to bring about a situation such as we are facing today.

Despite the fact that an opportunity was afforded correspondents to express an opinion regarding possible competition between live stock and deer on the wild range, this was mentioned as a factor in only

a few cases—ten, to be exact—enough to show that there is at least a potential problem presented by such competition.

An attempt to arrive at an estimate of financial loss to the State as a whole, as a result of deer feeding upon cultivated crops, would be an almost impossible task if one were dependent solely upon the figures contained in the deer damage reports. One individual may set the loss to his county at ten thousand dollars; another individual from the same county may arrive at a much lower estimate or indicate the financial loss as negligible. There are cases in which the repeated loss reported by an individual farmer far exceeds the estimated loss reported by some other correspondent for the entire county. We may assume, however, that the estimate submitted by an individual as to his own loss is more nearly correct. Out of the tangled mass of figures at our disposal the accompanying table has been assembled. It affords, however, only a very rough and incomplete picture.

TABLE 1

Estimates of financial loss due to deer damage to various individuals and counties in California

Estimated Financial Loss per Individual

County	Min.	Max.	Ave.	Total per county	Number of reports
Lake	\$60 00	\$2,000	\$588	\$2,940	5
Los Angeles	180 00	2,000	671	7,380	11
Monterey	20 00	2,000	168	1,170	7
Riverside	100 00	2,000	385	3,300	9
Siskiyou	100 00	1,500	663	2,650	4
Trinity	6 00	1,000	200	3,009	15
El Dorado	1 50	855	186	16,728	89

Total for seven counties----- 140

Average loss per individual in seven counties—\$265.50

Estimated Financial Loss per County

County	Min.	Max.	County	Min.	Max.
El Dorado	\$500	\$2,000	San Bernardino	\$1,000	\$12,000
Fresno	250	1,000	San Diego	1,000	5,000
Lake	200	3,000	San Luis Obispo	150	10,000
Los Angeles	500	1,000	Santa Clara	1,000	6,000
Mendocino	200	500	Santa Cruz	1,000	-----
Monterey	2,000	-----	Siskiyou	1,000	-----
Napa	1,000	10,000	Sonoma	10,000	-----
Nevada	500	-----	Trinity	2,000	-----
Orange	300	1,000	Tulare	100	-----
Riverside	2,000	3,000	Tuolumne	1,000	-----

Totals for twenty counties-----\$27,500 \$54,500

Average minimum loss per county—\$1,375

Average maximum loss per county—\$4,541

In 1930 a survey was made of damage by deer to orchards of El Dorado County, by Mr. Ivan W. Lilley, farm adviser, who has kindly supplied the following data. Due to his careful and painstaking work we are able to present a very complete statement of the financial loss to El Dorado County farmers as a result of deer damage. From about 300 questionnaires sent out, reports were received from ninety-eight farmers. Of these, eighty-nine reported damage to field crops, to young trees set back one to three years, and young trees killed which had to be replaced. The number of trees set back one year was 11,646, two years 9212, three years 8366; the number of one year trees replaced 11,812, of two year trees replaced 3625, of three year trees replaced 1931. The value of trees lost totaled \$27,584 (using cost records com-

piled by the University of California of \$0.90, \$1.40, and \$1.90 for one, two and three year old trees, respectively). The damage to field crops, owner's estimates, totaled \$9,915. The total damage reported for eighty-nine farms was \$66,667.84, or an average of \$740 per farm. The annual damage totaled \$16,728.27, or an average of \$185 per farm. The annual damage on farms varied from \$1.50 to \$855, and the total damage to individual farms from \$5 to \$872.

Concluding this general discussion of the deer damage situation, it will be well to consider more in detail the crops which are damaged and the nature of the damage to each type of crop. Deer, in those sections of California where they are in the habit of invading cultivated areas, enjoy a large and varied diet. During the study carried on by the Game Depredations Study Committee, those complaining of deer damage were asked to name the specific crops affected. The resultant list of crops (see Table 2), compiled from reports received by the committee and supplemented with observations by the author during his study of the problem in his official capacity as a member of the Division of Fish and Game, is appalling in its variety. If one were to call the roll of agricultural crops grown in California, there would be only a few among those present which could not be also found on the bill of fare of the deer.

For the sake of convenience the crops subject to depredations by deer will be considered under subheadings, as follows: orchard crops, truck crops, forage crops, cereal crops, and miscellaneous.

TABLE 2

Crops damaged by deer in California. Statistics obtained from questionnaires sent out by the Special Game Depredations Study Committee of the State Chamber of Commerce. Many correspondents reported damage to several crops; this explains the seeming discrepancy between the total number of reports received and the number of reports of damage for the several crops

Crops	Number of reports		Number of reports
ORCHARD:		TRUCK—Continued	
Apple	83	Squash	1
Pear	48	Artichokes	1
Prune	36	Truck gardens (misc.)	91
Peach	33	Total	144
Citrus	25	FORAGE:	
Apricot	20	Alfalfa	78
Avocado	14	Range	10
Cherry	5	Clover	5
Persimmon	1	Hay (?)	4
Plum	1	Vetch	1
Olive	1	Timothy	1
Almond	1	Sudan	1
Walnut	1	Total	100
Chestnut	1	VINEYARDS:	
Fruit trees (misc.)	26	Various varieties	94
Total	296	CEREAL:	
TRUCK:		Barley	3
Potatoes	9	Oats	3
Beans	7	Wheat	1
Corn	6	Grain	15
Strawberry	6	Total	22
Cabbage	4	MISCELLANEOUS:	
Lettuce	4	Flower gardens	18
Carrots	3	Seed gardens	15
Tomatoes	3	Bulbs	10
Peas	3	Acorns	2
Beets	2	Forest plantations	1
Melons	2		
Cauliflower	1		
Celery	1		

Heading the list by a large majority we find the orchard crops. There are 296 reports of damage to fruit trees of which 270 refer to specific varieties. The remainder are simply designated as "fruit trees" or "orchard." To some, the wide variation in the numbers of reports of injury to separate varieties might indicate that the deer are selective, preferring one variety of fruit tree to another. Granting that differences in palatability are undoubtedly a factor, there is little question that this variation is primarily due to crop distribution. In other words, the varieties of fruit trees which suffer the most damage are those which are grown extensively within the range of the deer. Apples, for instance, are found throughout the foothill and mountain regions of California and are grown on a commercial scale at higher altitudes than any other orchard crop. Is it not probable, then, that apple trees would be more subject to damage than other varieties of trees not so well adapted to mountain conditions? El Dorado, Lake and Mendocino counties are the finest pear producing sections of the State; and, they are among the first in amount of deer damage.

The greatest amount of damage to fruit trees occurs during the first one to three years after planting, since, during this period, the deer are able to reach the tender terminal shoots. If these shoots are destroyed during the early years, the tree suffers a serious set-back. Often, if these shoots are eaten early in the season, they will grow out again during the same year. If they are again destroyed death of the tree is a common result. Even if a tree does survive several attacks, it becomes so stunted and malformed that it never becomes an economic member of the orchard. That more trees are destroyed during their first year than in their second, and more in their second year than in their third, is borne out by the statistics obtained from the deer damage survey of El Dorado County, previously mentioned. It was found that, over the period of time during which the farmers of that county had been troubled by deer, it had been necessary to replace 11,812 one year old trees, 3625 two year old trees, and only 1931 three year old trees. The degree of susceptibility of a tree to deer damage decreases markedly with increase in age and consequent increase in height. In comparison to the amount of injury done to young trees, the amount done to mature trees is slight. In Santa Cruz County, the author has visited a number of orchards, planted before deer had become troublesome, in which it is impossible, due to the increase in the deer population, to rear young trees at the present time. The mature trees, however, show little evidence of damage. Damage to mature trees is limited, for the most part, to the "pruning" of the lower branches.

There is, as a general rule, little damage to the fruit itself, which is usually safely out of reach. Prune growers in Napa, Sonoma, and Santa Cruz counties, however, state that they suffer considerable losses due to the deer eating the prunes that have fallen to the ground. The truth of this statement is supported by the observations of the author, who has not only seen deer picking up prunes, but has seen the ground literally covered with the stones of the fruit that had been eaten previously. Some growers find that they can reduce their losses to a considerable extent by picking up all the prunes from the ground at the end of each day. Thus, the prunes that have fallen between morn-

ing and evening are saved and only those which may fall during the night are likely to be eaten by the deer.

The list of truck crops includes all of the common vegetables with the exception of spinach, turnips, radishes, cucumbers, egg plant, and peppers. In referring to the table, however, it will be noted that ninety-one of one hundred forty-four reports merely state that "truck crops" have been damaged and name no specific varieties. It might be possible that some of the common vegetables not included in the list would be found susceptible to damage if more specific reports had been made. In view of that fact, it would not be fair to state that deer will not eat those varieties. In reporting damage to truck crops correspondents did not differentiate between damage to the average farmer's kitchen garden, containing small amounts of a variety of vegetables, and the commercial truck farm of large acreage, devoted to the cultivation of, at most, only a few varieties. We know, however, that a number of the truck crops upon which deer have been known to feed are grown commercially within the deer range, principally in the coastal region south of San Francisco Bay; among them, beans, peas, lettuce, cabbage, cauliflower, and artichokes. In the northern part of the State, particularly in Shasta County, strawberry plants are grown commercially. Deer seriously damage some of these strawberry plantations not only by actually eating the plants, but by walking between the rows and thereby breaking the innumerable runners sent out by the "mother" plants. This latter procedure greatly reduces the yield of young plants with a consequent reduction in revenue. If one doubts the ability of the deer to subsist on a wide variety of forage, one has only to review the truck crop situation to have the omniherbivorous nature of the deer most emphatically emphasized.

The forage, or hay, crops, by virtue of including alfalfa within their ranks, are found to occupy third place on our list. Seventy-eight of the one hundred reports of damage to these crops refer to alfalfa. Where this crop is grown within the deer range, and much of it is, an immense amount of damage is done. One Lake County farmer writes, "I have two fenced alfalfa fields of approximately the same acreage. One has not been pastured this season (1930) and the other has supported a band of sheep throughout the summer. Deer have kept the unpastured field eaten down shorter than the field in which sheep have been kept. With the aid of a flash-light, I have counted as many as sixty-eight deer in the field at night." This is but one example of the injury that deer may cause the farmer who depends on alfalfa for all or part of his livelihood. There are numerous cases in which the farmer has been able to cut only one crop of alfalfa hay, the first, the deer keeping the green alfalfa cropped short during the remainder of the season. Losses of from three to thirty tons annually have been attributed to deer. That deer will travel long distances to feed on green alfalfa is shown by the authentic case of a buck, killed in Lake County at a distance of twelve miles from the nearest cultivated land. His paunch was found to be full of alfalfa. It is interesting to note, among the reports of damage to forage crops, ten instances of competition between deer and live stock on wild range. I. B. Barrass, Covelo, estimates that, during the 1930 season, deer destroyed one-third of his winter feed. While such reports are few in number, we have enough

information to show that the existence of such competition can not be overlooked.

Since, on our list of crops, the various subheadings have been arranged according to the actual number of reports received, vineyards must necessarily take fourth place. Damage to vineyards is, however, more serious than this position would indicate. In the opinion of the author, damage to vineyards is second only to that suffered by orchards. The individual vines composing a vineyard, like the trees of an orchard, are nonproductive during the first few years of their existence; in other words, until they become mature. After maturity the vines must be depended on to produce an annual crop. If a vine, like a tree, is injured during the course of any one growing season, the injury not only affects the crop for that season but for future ones as well. If this injury or series of injuries should result in the death of the vine it must be replaced. The new vine must be cultivated "for nothing" until it comes into bearing. It is easy to see that the farmer who must continually replace vines that have been destroyed will not reap large profits, since he will always be cultivating and caring for a number of vines that are not producing. The loss to the vineyardist is therefore greater than the loss to the truck or grain farmer who plants his crops annually, or to the maker of hay who grows the type of crop that can withstand periodic cutting back.

The greatest amount of injury to vineyards occurs when the first leaves are making their appearance in the spring. If the vines are defoliated during this period, the greater portion of the flower clusters—the embryo crop—are destroyed. In spite of the best cultural methods vines so injured will produce at best only a light second crop of grapes. Again comparing the vineyard with the orchard, it is found that defoliation of the vines causes them to suffer a severe set-back. Successive attacks result in death. Vines which have successfully passed through the early growing stage and have developed a wealth of foliage seem to lose much of their tempting qualities in so far as deer are concerned. However, where these animals are numerous and hungry, vines may be defoliated during the late summer and early fall months, even until the autumn-hued leaves fall to the ground. Not contenting themselves with the foliage alone, deer frequently vary their diet with the bunches of grapes. They strip the fruit from the stems, and, judging from the skins and seeds to be observed on the ground in the neighborhood of the vines, suck out the juices, discarding the above-mentioned parts. Often, rather than destroying a whole bunch, they will merely take a bite or two. It is needless to say, however, that even a slightly injured bunch of grapes has been rendered unmarketable. Although the author has noted no instance in which any one variety has remained immune to deer-invasion, it is evident that deer show a marked preference for some varieties. In Napa County, for instance, deer seem to prefer Petite Sirah, a wine grape; Muscats and other varieties of table grapes. Considerably less damage is done to some of the other wine grapes, such as Zinfandel and Burgundy.

Damage to cereal crops, or grain, is not very extensive, most of the reports of damage to this type of crop having originated in Trinity County. As a whole, very little grain is grown in deer inhabited areas, and while here and there a small grain field in a mountainous

area may be damaged, the total loss over the State can not be very large. Deer injure grain principally by nipping off the heads when in a green condition and by trampling down the stalks.

Injury to flower gardens, standing first under the subheading "Miscellaneous Crops," is, from the observations of the author, a more serious problem locally than the number of reports would indicate. Deer damage questionnaires that were filled out and returned referred to farming communities alone and did not include suburban areas, such as may be found in the vicinity of the Mount Tamalpais Game Refuge and in San Mateo County. The author has spent considerable time in the neighborhood of Ross, San Anselmo, and Fairfax, all towns bordering the Mount Tamalpais Refuge in Marin County; and if, from those towns alone, all reports of damage had been available, they would have amounted to many times the number actually received. The amount of damage done to gardens in this area is quite extensive, the semidomesticated deer entering them in broad daylight to feed on the choicest blooms. Damage to flower gardens, regardless of financial loss, is extremely annoying to the owners, many of whom have built homes in suburban areas that they might make a pastime of floriculture. The fact that most of the eighteen reports which have been listed originated in rural districts indicates, however, that such damage is not entirely limited to localities beyond the metropolitan areas. In these last it is merely aggravated. Deer will eat at least part of most of the common annuals, perennials and shrubs, showing a decided preference for roses.

Fifteen reports were received of injury to seed gardens. In no case, however, did the complainant specify the varieties of seed. The damage, here, is undoubtedly of the same type as might be found in any truck or flower garden and needs no further discussion.

A few bulb growers, particularly in Santa Cruz County, have suffered losses. Deer seem to be rather partial to gladioli and it is from those who grow these plants that the greatest number of complaints has been received. Deer usually begin working on a gladioli patch just before the first blooms appear, walking down the rows and removing the buds as they go. This destruction of the buds not only prevents the grower from marketing flowers but interferes with the "rogueing" that is necessary to keep varieties pure. Deer have also been known to eat freesias and narcissus. They do not seem to care for calla lilies, which are grown extensively in Santa Cruz County. Fortunately, the number of bulb growers who are carrying on their activities in close proximity to deer country is small, and, therefore, though the losses to individuals have been rather large in certain instances, the industry as a whole has not suffered to any extent.

Reports of damage to acorns came as something of a surprise, since they are not ordinarily considered in the category of agricultural crops. One of the complainants, a resident of San Luis Obispo County, made the statement that in the past he had been able to fatten 100 head of hogs annually on acorns on a certain area. In recent years, however, the deer had become so numerous there and had shown such a liking for acorns that he had been forced to abandon that profitable practice.

The Los Angeles County Forestry Department reports deer damage to a large percentage of their reforestation projects, the damage being localized in small plantations. The damage consists of nipping off the

tips of young trees, both conifers and hardwoods, particularly of Aleppo Pine, Incense Cedar, Big Tree, Black Locust, Arizona Ash and Carob. They also damage trees by trampling and rolling, and by making runs and beds throughout the plantations. Practically all the plantations are within a game refuge. On one plantation, in sample areas of staked Aleppo Pine and Carob, all of the trees were eaten; on another, 90 per cent of the trees died as a result of deer injury.

The subject of control of deer damage will not be discussed here. Of the three principal methods of control—fencing, the killing of deer doing damage, and the use of repellents—the former has been made the subject of a previous paper.* The killing of marauding deer has been made possible by recent legislation but, as yet, there are no results in hand upon which a discussion of the effects of that procedure can be based. A discussion of the use of repellents is of sufficient importance to warrant separate consideration and will, therefore, be made the subject of another paper.

OYSTER PESTS IN CALIFORNIA†

By HARVEY C. McMILLIN and PAUL BONNOT

CALIFORNIA has a native species of oyster (*Ostrea lurida*) which has great commercial possibilities but which has never been utilized to any great extent. From the beginning of the industry exotic species have been brought into the State with varying degrees of success. The growers have been encouraged to bring in the foreign oysters and their investments have been protected by legislation. There has, however, been no provision made for the inspection of incoming shipments and as a result some of the California bays have become heavily infested with the Eastern drill (*Uro salpinx cinereus*, Say) and the slipper shell (*Crepidula fornicata*, Linnaeus). The drill is always destructive but the slipper shell on its native heath, in the presence of its natural checks, is not harmful. When transplanted the slipper shell may become a serious pest in the new environment. The native oyster industry in particular has suffered from its introduction, and it is important that due consideration be given this species in the administration of the oyster resources of California.

The American slipper shell or "quarter deck" is normally scattered along the New England coast and southward to the Gulf. They usually inhabit tide pools and shallow water, clinging to rocks, shells and other solid objects. They appear most frequently in clusters of six to ten individuals attached one upon another to a single object. The life history and embryology of this form have been of interest to scientists for some time, and the facts concerning its growth and development of the species have been well worked out. Only in recent years has it become of economic importance as a pest on the oyster beds.

* Storer, T. I., and True, G. H., Jr., Deer Proof Fences in California, California Fish and Game, Sacramento, Vol. 17, No. 3, pp. 264-269.

† Printed with permission of the U. S. Bureau of Fisheries.

Recently the American slipper shell was introduced in the oyster producing waters of Great Britain through transplanting of American seed oysters. They have reproduced rapidly and have become a great menace to the oyster industry. In the lower end of Puget Sound where the native is produced in large quantities the slipper shell has become established. On the natural beds where the land has not been graded and diked the slipper shell does not grow in large numbers; on the artificial beds they are a serious problem.

The artificial beds are made up of a series of terraces each level of which is surrounded by a low dike which keeps two to fifteen inches of water over the bed at low water. The bottom is solid and covered with shell and oysters, making an ideal breeding place for the slipper shell. The damage by the pests is from three causes: (1) culling is made slow and difficult, (2) the pests occupy a large proportion of the room in the dikes designed for the oysters, and (3) from the condition of the oyster from infested areas it appears that the food of the oyster is taken by the slipper shell.

In the harvesting of some beds over half of the labor involved is in the handling of pests. More equipment is necessary to maintain production and the cost per bushel for harvesting is increased. If left on the beds the slipper shell would fill the dikes to the water level in a short time and prevent the growth of oysters therein. Removal of the pests from the beds is also necessary to prevent depletion of the food supply of the oysters.

It is possible that some means of biological control will eventually be worked out but at present removal by hand is the only relief. It is important, whenever possible, to prevent the introduction of pests of all kinds and avoid the serious loss which follows. At the present time we have no diked areas in California, but it is proposed to cultivate the native oyster in Humboldt Bay by this method. This place offers an ideal set of conditions for the industry and is entirely free from natural and imported pests. The introduction of detrimental species should be carefully avoided if the beds are to be made to produce to capacity.

Since the seed imported from Japan has been subjected to inspection the quality has greatly improved. At present practically nothing accompanies the oyster that is large enough to be visible. As an added precaution it would be well worth while to isolate imported seed as far as possible, and grow one species in each bay. In the case of Humboldt Bay it is strongly recommended that no opportunity be given to pests to establish themselves there. No foreign seed should be planted at any time regardless of its condition or the inspection it has been through.

CIRCLE GILL NETTING FOR SMELT*

By J. B. PHILLIPS

SMELTS IN THE MONTEREY FISHERY

A LARGE PORTION of the smelt catch of the Monterey wholesale fresh fish markets is brought in by operators of circle gill nets; the balance is delivered by operators of round haul and ring nets (a purse net). Circle gill netting is carried on during the months that the smelt are in shallow waters. When smelt move into deeper waters, during the winter months, netting operations are mainly with round haul and on occasions with ring nets. Smelt are landed at Monterey throughout the greater part of the year although peak poundage landings come in during the summer months.

The term "smelt" is a rather universal one. In California it is applied to the members of two families of fishes; the Osmeridae or true smelts, and the Atherinidae or silversides. The most outstanding, distinguishing characteristic of the two groups is the presence of an adipose fin in the Osmeridae and the absence of such in the Atherinidae. At Monterey the smelt catch is composed mainly of two members of the Atherinidae group: the jack smelt (*Atherinops californiensis*) and the bay smelt or panzarotti (*Atherinops affinis*). The grunion (*Leuresthes tenuis*), third California member of this group, is not present. The balance of the smelt catch is composed of whitebait (*Allosmerus attenuatus*), and surf smelt (*Hypomesus pretiosus*), members of the Osmeridae or true smelt group. From observations made during 1931, it is safe to say that throughout the year 90 per cent of the smelt landed at Monterey are jack smelt.

The bay smelt may be differentiated from the jack smelt by its slightly deeper body; its larger scales; the upper jaw projecting slightly over the lower jaw, whereas in the jack smelt both jaws are even; the back portion of lighter color than that of the jack smelt; the teeth being forked at the base, those of the jack smelt simple.

Circle gill netting for smelt in Monterey Bay is divided into two phases: the large jack smelt phase and the bay smelt phase. Circle gill netting for jack smelt may be termed a spring and summer fishery. It commences about April and usually runs into September or October. During this period the large jack smelt are in shallow water. With the movement of the jack smelt into deeper water in the winter months, this type of fishing ceases. Catches are then made with round haul and in a few cases with ring nets. Gill netting of smelt, when possible, is preferred to capturing by round haul or ring nets. The wild nature of the smelt when frightened makes the latter nets hard to handle while being pulled in. With a gill net the proper sized fish are helplessly gilled, and the net easily hauled in from one end.

Circle gill netting for bay smelt may be termed a winter fishery. Operations commence with the first appearance of the bay smelt during

* Contribution No. 120 from the California State Fisheries Laboratory, January, 1932.

the latter part of October or the early part of November, and may run into January or February. However, the heaviest catches are made during the first month or so of the "run." The catches then diminish and may be intermittent during the balance of the winter.

The basic principle of circle gill netting for smelt is to surround a school of desirable smelt with a net of webbing of uniform mesh. Then,

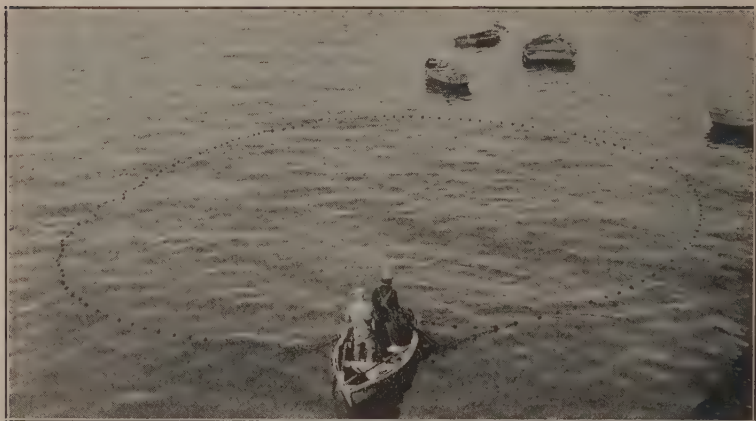


Fig. 32. A gill net laid out in a circle for smelt fishing. Photo by J. B. Phillips, November, 1931.



Fig. 33. Process of frightening smelt into gilling themselves while circle of netting is being decreased in size. The common method of "scaring" is as shown in Figure 34. Photo by J. B. Phillips, November, 1931.

as the smelt hover inside the circle with apparent uncertainty, they are frightened into gilling themselves by use of a "scare." The set is made in shallow water so that the lower edge of the net approaches bottom, thus preventing escape in that direction.

In general, a gill net is a rectangular strip of webbing hung flat between a cork line at the upper edge and a lead line at the lower edge. The mesh of this webbing is ordinarily all of one size but sometimes the net is lengthened by tacking on another section of webbing, the mesh of which may not be of the same size as the mesh of the previous section. The Division of Fish and Game regulates the minimum size of mesh to be used in certain districts and for certain fishes, so as to insure the escape of the smaller fish.

A gill net functions as follows: Fish that are smaller than the meshes of the net go through. Fish of a certain size-range are not so fortunate. In attempting to escape through the mesh of the net, the tapering head of the fish allows it to make forward progress until the bulkier portion just back of the gill covers causes it to wedge in the mesh. Finding that it can make no further forward progress, the fish attempts to back out. This is prevented by the twine of the mesh sliding under the gill flaps, with somewhat the same effect as an attempt to pull an umbrella through a chicken wire fence, handle first.

Inasmuch as there are some variations in the actual fishing performances in capturing jack smelt and bay smelt, these two phases of smelt fishing will be treated separately.

GILL NETTING FOR JACK SMELT

Gill nets used for jack smelt vary from 500 to 800 feet in length and are 25 to 35 feet in depth. The size of mesh varies from $1\frac{1}{2}$ to 2 inches, stretched mesh. Mesh in this size-range gills jack smelt of mainly 8 to 12 inches in length. The largest jack smelt of about 16 inches length, will weigh three-quarters of a pound each. However, there is more of a market demand for the medium sized smelt of about eight inches length and running about nine to the pound. So the tendency is to add mesh of the smaller size, when making additions or replacements to a gill net. Jack smelt may be taken anywhere along Monterey Bay. Sometimes the Monterey gill netters may journey to the flats off Capitola for their catches. When the jack smelt move into deeper water, with the fall and winter months, this type of fishing ceases.

Two men and a skiff ordinarily compose a circle gill net crew. The net is piled on the stern of the skiff. When traveling any distance, a motor-powered launch is used for transportation, the actual fishing being accomplished with the aid of the skiff. During the 1931 season, one crew was able to supply most of the market demand. Some seasons several crews operate. Most of the netting is done at night, while the moon is absent. The smelt are at this time located by the characteristic luminescence that they produce in the water. Tides are taken into consideration as fishermen find that smelt move in with the tide. Occasionally catches are made during daylight, but this method is only about a third as successful as the night fishing. When a desirable school of smelt is located one man commences to pay out the net over the stern of the skiff while the other man rows in a circle. When the circle is completed there is an overlapping of ends so as not to leave any opening. Where the ends overlap the cork lines are fastened together. The net now hangs in the water in the form of a cylinder; the buoyant property of the corks along the upper line keeps that edge

of the net at the surface of the water, while the weight of the leads along the lower edge of the net stretches the rest of the net downwards in the water. The smelt, in the meantime, hover rather uncertainly inside the circle. They are frightened into hurriedly gilling themselves (if of proper size) by the splashing of a brick or rock in the water or by the



Fig. 34. The more common manner of scaring smelt into hurriedly gilling themselves. One man propels the skiff inside the circular wall of netting, while the other man repeatedly throws a brick or rock into the water. The "scare" is tied to one end of a rope so that it can be retrieved. Photo by J. B. Phillips, November, 1931.



Fig. 35. Extricating bay smelt from a gill net that has been circled around a school of smelt. Photo by J. B. Phillips, November, 1931.

flashing of a light at or under the surface of the water. The "searing" is done by one man while the other rows around inside the circle. The brick or rock scare is tied to one end of a small rope so that it can be retrieved and used repeatedly. Sometimes, when the smelt are close to the beach, the circle is left open in the direction of the beach. The

skiff, during the "searing" process, works outward from the beach. This method is most effective if the mouth of a small cove can be blocked with the net. After the smelt have been frightened into gilling themselves, the net is pulled into the skiff, starting with one end, the smelt being extricated as it is brought in.

GILL NETTING FOR BAY SMELT

Gill nets used for bay smelt vary from 150 to 350 feet in length and 15 to 25 feet in depth. The size of the mesh used is ordinarily 1 to 1½ inches, stretched. This size of mesh gills smelt mostly of a 4- to 6-inch size, which run about 18 to the pound. For the past several years the catches of bay smelt for the Monterey markets have been made almost entirely in District 16. In the Penal Code of the State of California, District 16 is defined as "including those waters and tidelands to high water mark of that portion of Monterey Bay to the south of a line drawn from the extreme northerly point of Point Pinos in a



Fig. 36. A long gill net being divided into halves, after the initial circle is completed. The two smaller circles are then worked separately. Photo by J. B. Phillips, November, 1931.

straight line easterly to the eastern shore of Monterey Bay to a point north of the town of Seaside known as the 1st stake, a government survey monument." The most successful netting is just off of the Monterey sardine canneries and the fresh fish markets.

All of the bay smelt netting is done in the daytime. Two men in a skiff compose a gill net crew. The net is piled on the stern of the skiff, and circling operations are the same as those explained for the jack smelt. In practically all cases, the smelt are completely encircled with the net and the ends fastened where they overlap. The fish are frightened into gilling themselves by the use of a brick or rock "seare." One man rows the skiff around inside the circle, while the other man repeatedly throws the weight into the water.

Sometimes a long net is divided into two smaller circles after the initial large circle has been made, so as to facilitate "searing" operations.

A rare variation of the above netting performance is for one man to start drawing in the net from one end as soon as the circle has been completed, the other end being anchored to the skiff. As the net is being pulled in by one man, the other stands in the stern of the skiff and throws the "scare" into the water so as to prevent the smelt from



Fig. 37. Unloading a catch of jack smelt at Monterey. The launch is used mainly for transportation to and from the fishing grounds. The actual fishing is accomplished with the aid of one, and sometimes two, skiffs. Photo by J. B. Phillips, August, 1931.

passing under the boat and to frighten them back into gilling themselves as the circle diminishes in size.

A few days after the evident appearance of the bay smelt off Monterey, the catch by gill nets is about 90 per cent bay smelt and the balance mainly jack smelt. After the first month or so, the percentage of bay smelt in the catches decreases until their disappearance from the commercial catch about January or February.

About the time of the appearance of the bay smelt in the commercial catch, large catches of small jack smelt, called "fryers," also make their appearance. These are smelt that range in the main from three to four inches in length, and are caught with small meshed lampara nets in shallow water. Whereas the catches of bay smelt fall off after the first month or so of their appearance in the commercial catch, the catches of "fryers" are continuous throughout the winter months (depending upon weather conditions). Examination of the catches of "fryers" during the 1931 season showed them to be composed of jack smelt in the main. No bay smelt were found mixed in these catches. Often times, however, there are found up to 20 per cent of similar sized sardines and occasionally smaller amounts of whitebait and surf smelt.

OTHER DRIFT GILL NETTING IN MONTEREY BAY

As has been mentioned, the bay smelt phase seems to be confined entirely to District 16. A legislative enactment allows a drift gill net as the only type of net* that can be used for fishing in this district, except that a round haul net or a purse net may be used only for the purpose of catching squid, anchovy and sardines.

A set gill net is differentiated from a drift gill net, as follows: "A set gill net is one that is made fast in any way and shall not be free to drift with the tide or current, or a net so placed as to catch or impound fish within a bight, bay, or estuary against the shore upon the receding tide."

Drift gill nets, of about 4-inch mesh, are also used in the taking of various perches off the shallow rocky portions of the beach in District 16. Two men in a skiff operate the net. Instead of circling, the net is more often placed across an indentation in the shore or a small cove. Gilling of the fish in this case is accomplished by frightening the fish outward from the shore.

Gill nets are also used in Monterey Bay for the capturing of kingfish, herring, white sea bass and halibut, but these nets are more often in the nature of set gill nets.

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* Fyke nets, shrimp nets, or crab nets are not considered as set nets.

REPELLENTS AND DEER DAMAGE CONTROL

By GORDON H. TRUE, JR.

COMPETITION between wild deer and cultivated crops in California has, during the past decade, been steadily increasing until it has come to constitute a problem of considerable economic importance. The necessity of some action whereby the situation may be relieved has been recognized by the Division of Fish and Game and, as a result, considerable effort has been expended toward that end. One line of endeavor is represented by the investigation that has been carried on by the author in determining the role that repellents may play in deer damage control. It is the purpose of this paper to present the results of that investigation.

The author wishes to express his thanks to those who have aided him in this work. A number of farmers have gladly given assistance and various members of the patrol force of the Division of Fish and Game have devoted part of their time to this work. The author is indebted to Mr. E. M. Mills, U. S. Bureau of Biological Survey, for valuable suggestions.* Material obtained through the medium of questionnaires sent out by the Game Depredations Committee of the State Chamber of Commerce was also of aid.

At the outset of the investigation, all available data concerning repellents that had been used, not only in California, but in other sections of the country as well, were gathered together with the idea of subjecting to rigid tests those repellents which appeared to be of value. It is needless to say that these were found to be in the minority. The value of this preliminary survey lay in the fact that it brought to light the nature of the many difficulties to be encountered in attempting to control the depredations of deer by this means. Through it, also, the possibility was recognized that, guided by the experiences of others, a really practical, effective repellent might be found.

Actual field tests of various repellents have been carried on throughout the State during the past two years. Although these tests have not been entirely restricted to any one part of California, the greater portion of the experimental work has been carried on in Santa Cruz County and in the more mountainous parts of Napa, Sonoma and Marin counties. In selecting a location for a test it has been the practice to choose a farm on which only one type of crop is being grown and, if possible, one that is immediately adjacent to others on which the same crop is being grown under similar conditions. Thus, in the first place, the confusion that might arise from dealing with a variety of crops is eliminated and further, the neighboring acreages serve as controls. It is of the utmost importance that the owner or tenant of the land on which a test is to be made be in sympathy with the investigator and willing to assist in the work. The observations of the farmer must of necessity be depended upon to a certain degree and his aid is often required in the application of repellents.

* Mills, E. M., *The Fruit Grower and Deer Damage*, The Rural New Yorker, Vol. 89, No. 5108, pp. 658-659, May 17, 1930.

Let us define a repellent in this case as any substance or combination of substances which, due to its odor, taste or fear instilling qualities, will serve to protect agricultural crops from the depredations of wild deer. Repellents may be divided into two classes; namely, chemical repellents, which act through the effect they may produce on the sense of smell or taste, and devices which intensify the deer's natural wariness. The first class includes those substances which may take the form of sprays or dusts, applied directly to the foliage, or may be effective through merely being placed in the proximity of the form of plant life to be protected. The second class is represented by the noise makers and other contrivances which are calculated to frighten deer which approach them. It is not sufficient that a repellent be effective. In addition it must be reasonable in price, easily and quickly put into operation and must retain its repellent properties over a reasonably long period of time. The two classes of repellents will be discussed separately.

CHEMICAL REPELLANTS

The first group of chemical substances to be discussed are animal by-products of the meat packing industry; namely, blood, ground blood meal, ground meat scrap, digester tankage and ground bone meal.

Blood has been employed successfully as a spray for the protection of young cherry trees in the H. Gansberger and neighboring orchards situated in Palomares Canyon, between Dublin and Hayward, Alameda County. Fresh warm blood was obtained from a neighboring slaughter house, placed in containers and stirred until cool. After the stirring process all coagulated material was removed and the containers were placed in the sun until their contents had become more or less decomposed. An equal volume of water was then added and the evil smelling mixture was sprayed on the foliage of the young cherry trees by means of an ordinary knapsack sprayer. If the application was repeated at intervals of from one to two weeks, this method resulted in almost 100 per cent control. Rags dipped in blood and hung about the orchard or vineyard have been made use of in some sections with varying degrees of success. Vineyardists in the vicinity of Geyserville, Sonoma County, painted the grape stakes with blood but found that that treatment must be renewed too frequently to be practical. In no case has the blood treatment been as effective as when used as a spray, according to the method outlined above. The use of blood as a repellent is, unfortunately, limited by the supply. There are few cases where that material may be obtained in amounts large enough to control deer damage over an area of any size.

Blood meal, ground meat scrap and digester tankage are all employed in a similar manner and, if frequently applied, will afford a considerable degree of protection, i. e., from 50 to 100 per cent. These substances may be used in the dry condition or mixed with water. In the first case the material is merely sprinkled on the foliage. The wet mixture is best applied by throwing it on the foliage with a whitewash brush or whisk broom. Since it is necessary to repeat the application of the above substances at intervals of a few days, they are not practical for use on large acreages. If used in an ornamental garden they have the disadvantage of being unsightly. Mr. J. A. Winkleman, Placerville, reports that blood meal, mixed with water and allowed to putrefy,

has given good results in some places in El Dorado County. Meat scrap has been effective in the protection of young apple trees on the ranch of Mr. F. C. Clarke, Laytonville, Mendocino County. The best type of meat scrap is that which possesses a putrid odor and may usually be obtained from the small-town butcher. It is much more satisfactory than the ordinary commercial grades which often lack that necessary quality.

Bone meal was recommended to the author as an excellent repellent but has proved to be almost without value, both in the dry condition and mixed with water. It is almost without odor and, the particles being extremely fine, is readily blown away.

Current prices for the above materials per cwt. are: ground blood meal \$2.75, ground meat scrap (commercial) \$2, digester tankage \$1.50, and ground bone meal \$1.50. No prices are quoted for whole blood.

D4

In July, 1930, Bulletin Number 1, of the New Hampshire Department of Fisheries and Game, was received by the author. The bulletin was in the nature of a progress report dealing with D4, a proprietary spray for deer damage control that had been used in New Hampshire with considerable success. A supply of D4 was obtained for trial under California conditions. D4 is applied as a water solution, one part of the former being mixed with sixteen parts of the latter. Nothing has been divulged concerning its composition. It is distributed by the Merrimac Farmers' Exchange, Concord, New Hampshire. The retail price is \$2.50 per gallon f.o.b. Concord.

Experimental work with D4 was begun on January 29, 1931, at Ross, Marin County, California. On that date two adjacent rose gardens on Southwood Avenue were sprayed with the repellent. On February 5th two gardens directly across the street were similarly treated. The spraying was done with a 2½ gallon pressure sprayer of the type commonly used in the control of insect pests. Inspections at intervals of one week were made throughout the course of the experiment, which was terminated on April 18, 1931. At the time of the first application of D4 the leaf buds were just opening and the work was continued until the roses were in full bloom. At each inspection the gardens were carefully examined for evidence of damage and for the tracks of deer. Only twice were tracks observed and only once, on April 10th, were there any signs of damage. On that day it was observed that two shoots had been taken from one rose bush. The gardens were sprayed four times during the experiment. It was deemed necessary to repeat the applications because of the rapid growth of the plants with continual production of new foliage. There were also several showers of rain which, it was feared, might have washed the repellent from the plants.

The results of this experiment would seem to indicate that D4 had successfully protected the rose gardens from deer damage, since, during the corresponding period in 1930 the rose bushes had been completely defoliated. Also, during the course of the experiment, rose gardens in the immediate vicinity of those treated had suffered considerable injury. On the other hand, the almost complete absence of deer tracks in the gardens indicates that D4 did not receive a thorough trial, for it is inconceivable that a repellent of that nature would keep

deer entirely out of the areas over which it had been applied. The time of year must also be taken into consideration. During the early spring months there is an abundance of wild forage in the vicinity of Ross and, consequently, deer are not driven to cultivated crops as they are later in the summer when the wild forage has become dry.

On May 5, 1931, a prune orchard belonging to Mr. W. R. Truitt, Bonny Doon District, Santa Cruz County, was sprayed with D4. The ten acre orchard is bounded by a road on one side, by abandoned vineyard and pasture land on another, and by wild land on the other two. Deer had been doing more or less damage to the prune trees for a period of ten years. During the past few years it had been necessary to replant an average of one hundred trees per year. In the western half of the orchard, a block of 176 trees of all ages was sprayed, while the remaining 128 trees were replants scattered about the remainder of the orchard. Twenty-one trees had already been damaged and these were marked with tags. Nine gallons of spray were used. The application took one hour and a half.

Inspection of the orchard on May 16th revealed no sign of damage to untagged trees. On May 27th it was found that a number of trees had been injured. The latter inspection was made just following a rain of two days duration. The orchard was literally full of deer tracks. Whether the injury had been done before or after the rain could not be determined. The trees were resprayed on May 27th, the trees damaged since May 5th being tagged. On June 12th the orchard was visited for the fourth time and it was noted that nearly all of the small trees had been nibbled, and lower branches of the larger trees, in the west end of the orchard, had been partially defoliated. There had been rain on the 5th of June. The orchard was sprayed again on that day. After June 12th the damage became continuous and by the end of the month all of the smaller trees had been almost completely denuded of leaves. No further applications of D4 were made.

During the early part of November, 1930, a supply of D4 was sent to R. A. Browne, Castella, Shasta County, in order that it might be given a trial with reference to the protection of a strawberry plantation that had been damaged extensively by deer. The spray was first applied on November 20, 1930, and was apparently effective for a period of one month. At the end of the month winter snows set in and made further applications not only impossible but unnecessary. Sixteen gallons of the spray were required to cover slightly less than one-half acre of strawberry plants. Mr. Browne reported that during the month following the application of the spray deer had entered the plot but had done no feeding. The only damage consisted in the breaking of the runners from some of the plants by deer walking between the rows. During the summer of 1931 the strawberry plants were sprayed again and within two weeks several deer consumed the entire crop.

G. Mancardi, Laurel, Santa Cruz County, used D4 on young prune trees and reported serious injury by deer after a period of three to four days. E. D. Rodgers, Swanton, Santa Cruz County, found that deer regarded gladiolus buds as palatable at from four to six days after treatment with the spray.

From the experimental data concerning D4, we may draw the conclusion that that material is not an effective repellent under California conditions. Although it is reasonably effective during the winter and early spring months when green wild forage is available or when untreated crops are in the immediate vicinity of crops that have been sprayed, it has little repellent effect during the dry summer months when deer are forced to resort to cultivated crops for succulent food.

WHALE OIL SOAP—LIQUOR CRESOLIS COMPOUND

A spray composed of liquid whale oil soap and liquor cresolis compound (surgical) has been used with good results for the protection of vineyards. Early in the course of this investigation, the author observed that whale oil soap had, for a short period, a decided repellent effect. After some experimenting it was found that this repellent effect was increased and lasted for a longer period of time upon the addition of a small amount of liquor cresolis compound (surgical). The proportions used were five gallons of liquid whale oil soap and two quarts of liquor cresolis compound to one hundred gallons of water. On the basis of ten gallons of water, two quarts of the whale oil soap and fourteen tablespoonfuls of liquor cresolis compound should be used.

On June 1, 1930, the vineyards of Mr. G. Gaudino and F. Caldera, Atlas, Napa County, were sprayed with this material. The vineyards, comprising some twenty-five acres in all, are isolated and completely surrounded by wild land except where they adjoin each other. Both had been damaged considerably by deer. The spray program involved the spraying of a strip six vines wide around the vineyards with the exception of one block of 650 newly grafted vines in the Gaudino vineyard. In the case of the latter all the vines were sprayed. A fifty gallon barrel mounted on a horse drawn sled and supplied with a hand pump was used to apply the spray. Although the vines had been injured to quite an extent during the early part of the season, the deer left the vineyards strictly alone until the 21st day of June when a few vines in an isolated corner of the Gaudino vineyard were damaged. The vineyards were sprayed again on June 26th. This second application was effective until the second day of August. At this time it was deemed inadvisable to continue with the spraying since further use of a liquid spray might have resulted in injury to the grapes, which were rapidly maturing. The owners of the vineyards were satisfied with the use of the spray. During the months of June and July the vines had become full grown and consequently less palatable to the deer. After the cessation of spraying the only damage done was the nibbling of the ends of some runners and a few bunches of grapes.

During the month of October, 1930, a visit was paid to the vineyard of Mr. W. R. Depew, Bonny Doon District, Santa Cruz County. It was found that the vineyard had been almost completely defoliated by deer. The vineyard had been similarly damaged in 1929 and to a less extent in 1928, the first year that the condition had become noticeable. It was estimated that deer had destroyed eighty-five per cent of the 1930 crop. The four acre vineyard is bounded on two sides by apple orchard and on the other two by wild land.

In the spring of 1931, just prior to the growing season, the owner of the vineyard was supplied with a quantity of whale oil soap and liquor cresolis compound and was instructed to spray the vineyard at the first sign of deer damage. The first spraying was done on the afternoon of the 25th and the morning of the 26th of March. Sixty gallons of spray were used. There was no further damage until April 24th when a few vines were slightly injured. On the same day the vineyard was sprayed for the second time. Ninety gallons were required for the second spraying, this increase being due to the larger amount of foliage to be covered. A heavy shower washed the repellent from the foliage and thereby necessitated a third spray application on May 7th. Sixty gallons were used. There were no further spray applications during the remainder of the season since the owner was hesitant with regard to the use of a liquid spray on the vines while the bunches of grapes were maturing. During the period extending from March 26 to June 1, 1931, less than two dozen vines were injured and these not seriously. Fresh deer tracks could be seen in the vineyard at any time. The vines were in excellent condition and showed no signs of injury that might have been attributed to the spray. Since further use of a liquid repellent was impractical another method was resorted to that successfully protected the vineyard for the remainder of the season. The nature of that method will be discussed under another heading. The cost of materials for the protection of the vineyard for the period mentioned was \$2.34 per acre for materials. Three days labor by two men was required for the three applications. The spray was applied by means of a 100 gallon orchard spray machine.

The whale oil soap-liquor cresolis spray was used in an attempt to protect gladioli at the nursery of E. D. Rodgers, Swanton, Santa Cruz County, and was effective for periods varying from six days to two weeks. The author attempted to prevent deer injury to the vineyard of G. Luchesi, Yountville, Napa County, with the same spray. The results of that experiment were disastrous. One can not spray a fifteen acre vineyard with a two and a half gallon spray gun and keep ahead of the deer and the weather.

Since, in the case of vineyards, the critical period is during the early part of the growing season, the whale oil soap-liquor cresolis compound spray may be recommended for use at that time. It has been found that if a vineyard is afforded protection during this critical period the damage later in the season will be slight in most instances. Deer do not find old foliage nearly so palatable as the tender shoots of the first spring growth. This spray should not be used on trees as it will burn the foliage. If used in the recommended proportions, however, there will be absolutely no burning of grape vines.

Liquid whale oil soap may be obtained from any spray dealer and liquor cresolis compound (surgical) from any druggist. Michel and Pelton, Emeryville, California, quote the following prices for the above materials: whale oil soap (liquid), fifty-five gallon drums, \$0.55 gal.; five gallon cans, \$3.50; one gallon cans, \$1; liquor cresolis compound (surgical), thirty gallon drums \$1.50 gal.; five gallon cans, \$1.65 gal.; one gallon cans, \$1.80. Five gallon cans containing whale

oil soap and liquor cresolis compound already mixed may be obtained from the same concern \$4.25 per can.

NAPHTHALENE FLAKES

Naphthalene flakes have proved to be an effective repellent for the protection of young orchard trees. The naphthalene method has been employed in various orchards throughout the 1930 and 1931 seasons and has resulted in from ninety-five to one hundred per cent control. In preparing naphthalene flakes for use, two tablespoonfuls are placed in a piece of white muslin about eight inches square. The corners of the cloth are then tied together to form a small bag. One of these bags is hung in each tree to be protected about three feet from the ground. In the humid coastal region one treatment lasts for approximately two months. Where atmospheric moisture is low the treatment must be renewed as often as once a month. Successive treatments must overlap, that is, a fresh supply of the repellent must be put on before the material used for the preceding treatment has completely evaporated. In the case of trees over two or three years old it is wise to increase the number of bags to two or three per tree, depending on their size.

Naphthalene flakes were used in the protection of young prune trees in the orchard of Mr. J. Haub, Geyserville, Sonoma County, during the summer of 1931. Prior to treatment with naphthalene a number of the trees in this orchard had been injured to quite an extent. Naphthalene bags were put out and a smooth circle was raked around the base of each treated tree. Although deer tracks were frequently observed on the raked areas, no further damage was done throughout the remainder of the season. Control, in this instance, was 100 per cent. In November, 1930, the Thornhill Broome Estate, Oxnard, Ventura County, found itself faced with a serious deer damage problem. Deer were rapidly making away with a newly planted orange grove. Naphthalene flakes were recommended and, at once, 1700 trees were treated. The naphthalene was placed in small sugar sacks obtained from a nearby refinery and was in the form of moth balls rather than flakes but, in principle, the method was correct. On February 30, 1931, Game Warden R. E. Bedwell, Ventura, reported that deer damage control in the Broome orange grove had been 100 per cent.

On May 4, 1931, young apple trees in the orchards of Mr. Harry Baker, Mr. William Ryder, and Mr. Glenn Spencer, Aptos, Santa Cruz County, were treated with naphthalene flakes. The Ryder orchard, the most open to attack, suffered only a slight amount of damage throughout the rest of the summer, about five per cent. In the Baker orchard injury to treated trees was negligible. A number of trees in this orchard were left untreated and these were destroyed. The Spencer orchard remained undamaged until the latter part of June when the owner neglected to renew the supply of naphthalene which, by that time, had evaporated. A large proportion of the young trees were then destroyed. The Ryder and Baker orchards were treated three times, at intervals of approximately two months, during the season. It is significant that in the three Santa Cruz County orchards considered here, the rearing of young trees had been regarded as impossible due to the certainty of their destruction by deer. Mr. Ryder lost almost

his entire plantings for at least three years before naphthalene was used. With the advent of the naphthalene treatment the owners of the orchards were able to bring young trees through the 1931 season successfully.

Naphthalene flakes may be obtained in fifty pound lots for \$0.11 per pound. In smaller amounts the price will vary from \$0.15 to \$0.20 per pound. Even at the latter price, however, the treatment is remarkably inexpensive. Using one bag to each tree one pound will treat ten trees.

ASAFOETIDA

Gum asafoetida may be employed in the same manner as that recommended for naphthalene flakes, a piece of the soft gum about the size of a golf ball being placed in each bag. Although asafoetida has not been as effective as naphthalene, it has the advantage of lasting for a longer time. The material is effective as long as it remains in a soft condition but when it becomes hard, the odor is lost and it must be renewed. In Santa Cruz County one application proved to be sufficient for an entire summer. In northern Sonoma County the asafoetida became hard and worthless in about three months. Gum asafoetida costs \$0.25 per pound in fifty pound lots. One pound will treat twelve trees.

CREOSOTE

Creosote and creosote dips have been widely used for the purpose of deer damage prevention but in most cases the method has met with little success. The usual procedure has been to saturate strips of cloth with the liquid and hang them at various points in the vineyard, orchard or garden. Since the strips of cloth are exposed to the sun and wind, the creosote rapidly evaporates and the repellent effect is lost within a few days.

Game Warden J. D. Dondero, Lakeport, Lake County, evolved a method whereby creosote becomes more effective, particularly in the case of orchards. Heavy woolen material (old blankets, overcoats, etc.) is cut into pieces ten to twelve inches square. Each piece is then rolled into a tight ball and secured with a piece of hay wire. The balls are then soaked in creosote or sheep dip until they become thoroughly saturated. One is then hung on each tree in such a manner that none of the liquid will come in contact with the tree and injure it through burning. The balls of cloth must be redipped at intervals of from two to three weeks. The fact that the pieces of cloth are rolled into balls cuts down evaporation and is the basis for the success of the Dondero method. The method has been responsible for almost one hundred per cent control in several Lake and Napa County orchards. It is primarily designed for orchard protection, being much less effective in the case of vineyards and gardens.

Agricultural Commissioner J. A. Winkleman, Placerville, El Dorado County, has outlined a method of using creosote that has been employed successfully by some of the orchardists in El Dorado County. In principle, it is identical with the Dondero method. Small pieces of wood about the size of playing cards are dipped in creosote and suspended in young trees by means of wire. The chips are redipped about twice a month.

Creosote costs 50 cents per gallon in 50-gallon drums.

SLUTMAN'S FORMULA

It will be remembered that, in connection with the use of whale oil soap and liquor cresolis compound in protecting the W. R. Depew vineyard, Santa Cruz County, another repellent was used after further use of the liquid spray was considered unsafe. The repellent that was used is the invention of Mr. William Slutman, La Canada, Los Angeles County, and was used by him in the successful prevention of deer damage to his vineyard during the 1931 season. Mr. Slutman allowed the author to use the dust under the condition that the formula be not divulged. Consequently nothing can be said here concerning the nature and composition of the repellent. Mr. Slutman has been busy perfecting his concoction and expects to place it on the market, where it will be available to those who wish to make use of it for deer damage control.

SCARING DEVICES

Scaring devices of many kinds have been widely used in an effort to prevent deer damage. Such devices, while serving as deterrents for a short time, have been ineffective as long-time control measures. Deer invariably become accustomed to them. Probably the most striking instance of this is the automatic flash gun.

The automatic flash gun is a contrivance especially designed to frighten wild animals and birds. The machine is operated by carbide gas and is so arranged that the gas explodes at intervals of from two to ten minutes. The explosion may be compared with the report of a .30 caliber rifle. In addition to the periodic explosions, the pilot burner throws a beam of light. The machine is hung from a tripod and, at the point of attachment, is fitted with a swivel. As the gun swings about in the wind the beam of light is thrown in all directions. An automatic flash gun was put into operation at the nursery of Mr. E. D. Rodgers, Santa Cruz County. The deer were naturally considerably frightened at first but after the machine had been in use for about a week they could be seen feeding in its light, merely raising their heads in mild annoyance at the sound of each explosion.

Scarecrows resembling humans have been used extensively with little or no effect. Strips of white cloth or pieces of bright tin strung on lines are seldom of value for more than a few days, a week at the most. The discharge of firearms may frighten deer at first but, like the automatic flash gun, effects no permanent cure. One farmer hung kerosene lanterns at various points in his vineyard. When questioned as to the success of the method he remarked that the deer seemed to appreciate his efforts in their behalf. He had merely provided them with light by which to feed. Lake County farmers who tried the same method in alfalfa fields came to the same conclusion.

Many have tried the effect of bird shot upon hungry deer but find that, though the deer leave their nocturnal repast at the time of the bombardment, they usually return to the feast within an hour or two. The control accomplished by this method has not been sufficient to warrant the expenditure of ammunition and the loss of sleep that it necessitates.

Dogs have been used with varying degrees of success depending on the type of dog that the landowner happens to have in his possession. Hounds have been generally unsuccessful since they take one deer out

across the country leaving the rest to continue with the work of destruction. The mongrel shepherd, barking at anything and everything will keep deer away until he gets tired of the sport. In many cases that type of dog has been remarkably effective. The best dog that has come to the author's attention was one that continually ranged the brush around his owner's vineyard during the day time. He was hunting rabbits and squirrels and kept up a continual clamor. It is safe to say that no deer bedded down in the neighborhood of that vineyard and consequently there were fewer to enter it at night. The dog's master ascribed his lack of deer damage entirely to the dog. His neighbors all had been damaged extensively. Few are the instances, however, in which dogs have consistently afforded protection over a long period of time. In most cases, though at first antagonistic, the dog and the deer become accustomed to one another and, like the lion and lamb, they lie down together.

CONCLUSION

The effectiveness of any repellent has been found to be dependent on a number of conditions. Such factors as temperature, rainfall, the number of deer in the neighborhood, and the relation of the property to wild land all have their effect. The combination of such factors in any one place will often be the deciding factor in determining whether or not a repellent will give satisfactory results and to what degree. A method that has been highly successful under one given set of conditions may prove entirely worthless under another.

In conclusion it may be stated, that while the ideal repellent has not been found, there are materials that will greatly reduce the amount of deer damage. Whether or not any of the repellents herein described be used is, of course, up to the individual farmer. In those cases where the amount of deer damage is small, the expense connected with the use of repellents, though not great, will probably not be justified. In cases where deer are causing real losses, however, the saving accomplished through the use of repellents will more than counterbalance the cost of control.

COOKING AND CLEANING LOSSES IN CANNING TUNA¹

By D. H. FRY, JR.

THIS WORK was carried out to learn how much weight tunas lose at different stages in the canning process. The amount lost in cleaning is of interest to statistical workers who frequently have to convert cleaned weight into round weight; while law enforcement officers have to be sure that the cleaned fish in canneries were not under the legal weight limit when round. Besides this, cannery officials like to know when the loss at any one step in the canning process becomes excessive.

¹Contribution No. 121 from the California State Fisheries Laboratory, January, 1932.

When tunas are taken to a cannery, they are first weighed then given to cleaners, who remove the entrails. The next process is to steam-cook the fish for a length of time, which varies with species, size, fatness, etc., then they are allowed to cool, and sometimes to stand an extra day. After this the head, skin, dark meat, fins, and bones are removed, leaving nothing except white meat which is then sliced and placed in cans with a little oil and salt.

The first load examined consisted of iced yellowfin tuna from Mexico. Sixty of these fish, ranging in weight from six to twenty pounds, were taken from the cannery floor a few at a time, weighed, placed on a cleaning table and reweighed after they had been given the preliminary cleaning by regular cannery workers in the routine manner.²

The fish examined were then placed on trays and steam-cooked in the standard way. The rack containing the trays was marked and each tray numbered to make it easy to keep track of the fish and to reweigh each one after cooking. To get the weight accurately it was frequently necessary to make use of the theorem, "the whole is equal to the sum of all of its parts." In other words, the fish were much inclined to lose outlying portions of their anatomies as they were removed from the trays. The length of time the yellowfin were cooked was not ascertained, but was the same for all—a condition which would not be likely to occur ordinarily as larger fish are usually cooked longer.

One hundred and three skipjack were treated similarly. These fish were also from Mexico and had been on ice for ten days. Cooking in this case was for three hours at 220 degrees Fahrenheit. The rack was weighed ten hours after cooking and again twenty-four hours after that to ascertain the loss on standing. After the second weighing of the rack the individual fish were weighed and returned to the rack. They were then taken to the cleaning room and given to two regular employees of the cannery who removed skin, dark meat, bones, and in fact everything but the white meat which goes into the can. The white meat of each fish was weighed separately.

In examining the figures it should be borne in mind that they are the result of only one run of fish of each kind, that differences in the technique of the cleaners, length of cooking time, temperature used, fatness of the fish, and so forth, will each undoubtedly make some slight difference. Just how much could not be determined without an exhaustive series of tests. The figures therefore do not claim to be more than an approximation.

Yellowfin	Per cent of round weight lost	Per cent of round weight remaining
Yellowfin tuna (6 to 20-pound fish):		
Preliminary cleaning -----	7.5	92.5
Preliminary cleaning plus cooking after about 10 hours standing -----	36.0	64.0
Skipjack (3½ to 10½-pound fish):		
Preliminary cleaning -----	7.0	93.0
Preliminary cleaning plus cooking after about 10 hours standing -----	34.0	66.0
Preliminary cleaning plus cooking loss after about 34 hours standing -----	35.0	65.0
Total loss after final cleaning had removed everything but white meat -----	69.0	31.0

² To carry out this preliminary cleaning the worker makes a small, lengthwise slit in the body cavity, then while reaching in and grasping the viscera with one hand, cuts them loose from the head with the other; a heave then slides the fish on its way and removes the viscera. The process takes less than five seconds. The fish are then rinsed and placed in the cooking racks.

This table gives the total loss up to and including each step mentioned. Percentage of round weight lost *at* each step can be figured by subtracting the loss up to and including the *previous* step from that including the stage in question; for example, the loss of skipjack on standing is 35 per cent less 34 per cent leaves a result of 1 per cent of round weight.

PRELIMINARY CLEANING LOSS

Preliminary cleaning loss appears to be about the same for all sizes of fish of the same species, *i. e.*, a small fish loses the same percentage of its weight as a large one.

PRELIMINARY COOKING AND CLEANING LOSS

Given the same amount of cooking, a small fish loses a slightly greater percentage of its weight than a large one. This is easily explained by the fact that the steam does not have to penetrate as far in a small fish and consequently cooks it more thoroughly in a given length of time. The skipjack sample under discussion would indicate that four-pound fish lose on the average about 1 or $1\frac{1}{2}$ per cent more than eight-pound fish (*i. e.*, $1-1\frac{1}{2}$ per cent of round weight).

LOSS ON STANDING

A load of skipjack which, when round, had weighed 622 pounds lost about seven pounds after standing an extra 24 hours, *i. e.*, about 1 per cent (the large platform scales used for this weighing would not check themselves within a pound).

TOTAL LOSS INCLUDING FINAL CLEANING

Here again the percentage loss is greater for small fish. In this case the difference seems to be about the same as that caused by the cooking ($1-1\frac{1}{2}$ per cent). Probably about half of this is due to cooking and half to the loss of small bits of white meat which the workers consider big enough to be worth saving from large fish, but not from small. Roughly half of the cooked fish is left after the final cleaning. Any loss which will amount to say $1\frac{1}{2}$ per cent of the round weight in the cooked fish will be reduced to about one-half of that after the final cleaning, since one-half of the shrunken material is discarded and does not enter into the final weighing. There is a possibility that the waste parts of the fish, such as the head, dark meat, fins, etc., may lose nearly all that they are going to in the first part of the cooking, and that from then on the largest part of the loss is sustained by the white meat. This of course would invalidate the statement made above.

As mentioned at the beginning of the article the final cleaning was done by two workers. They happened to be quite different in technique and in the amount of white meat they retained. One worker in scraping off skin, dark meat, clotted blood, etc., retained white meat to the extent of 32 per cent of the round weight of the fish. This operator used long strokes of the knife and rarely went over the same ground more than once. The other worker was inclined to be more fussy and scraped with short strokes, quite frequently over the same ground. She retained white meat to the extent of only 28 per cent of the original weight. The difference would amount to about 80 pounds of

canned tuna per ton of fish. The worker who used long strokes, in addition to retaining a higher percentage of white meat, was able to clean about sixty fish while the other was doing twenty-six.

If the differences in the method of cleaning consistently produce this result, it would certainly be worth the while of the canners to teach the workers to use the more efficient method. We have no way of knowing if this would prove to be the case. Only two workers were tested and the differences in skill of these two might mean far more than the differences in method.

I wish to thank Richard S. Croker of the California State Fisheries Laboratory for his assistance, and the officials and employees of the local (Los Angeles harbor district) tuna canneries for their cooperation in this work.

A SIMPLE METHOD OF AGE DETERMINATION OF STRIPED BASS

By EUGENE C. SCOFIELD

HOW OLD was that striped bass which you caught several years ago? Find the record, get its length, then refer to figure 1. This chart offers a simple method by which you can obtain the age of any female striped bass between the lengths of 1 and 48 inches.

Comparatively recent research on the life history of the bass (E. C. Scofield, Cal. Div. Fish and Game, Fish Bull. No. 29, 1931) has enabled the author to establish very definitely the age, rate of growth and the weight-length of this species. However, due to the lack of sufficient data there has been some uncertainty as to the accuracy of material exceeding 30 inches in length. Through the courtesy of various sportsmen of California there have now been gathered data from about 200 female bass, all of record size, or exceeding 30 inches in length. These data have made possible the completion of the age-length, and length-weight curves as presented in figure 38.

The chart not only shows the age of a female striped bass of a given length, but it also presents a few other facts of general interest. Observe the age-length curve, perhaps more commonly called the growth curve. It will be seen that a striper grows much faster in its earlier life than later when it is eight or nine years old. For example, it grows 6 inches during its second year, while during its eleventh year it grows but 2 inches. In its twentieth year it only grows 1 inch.

Now turn to the length-weight curve. The order is here reversed and we find that as a bass grows it takes on more and more weight in relation to its increase in length. Until a bass reaches a length of 12 inches it is less than one pound in weight. When it is 36 inches long it weighs about 19 pounds. However, when it is 51 inches it is 53 pounds in weight.

Referring back to the age-length curve once more, we can observe that when a bass has reached the ripe old age of twenty years she is still growing considerably since there is no indication of a tapering off

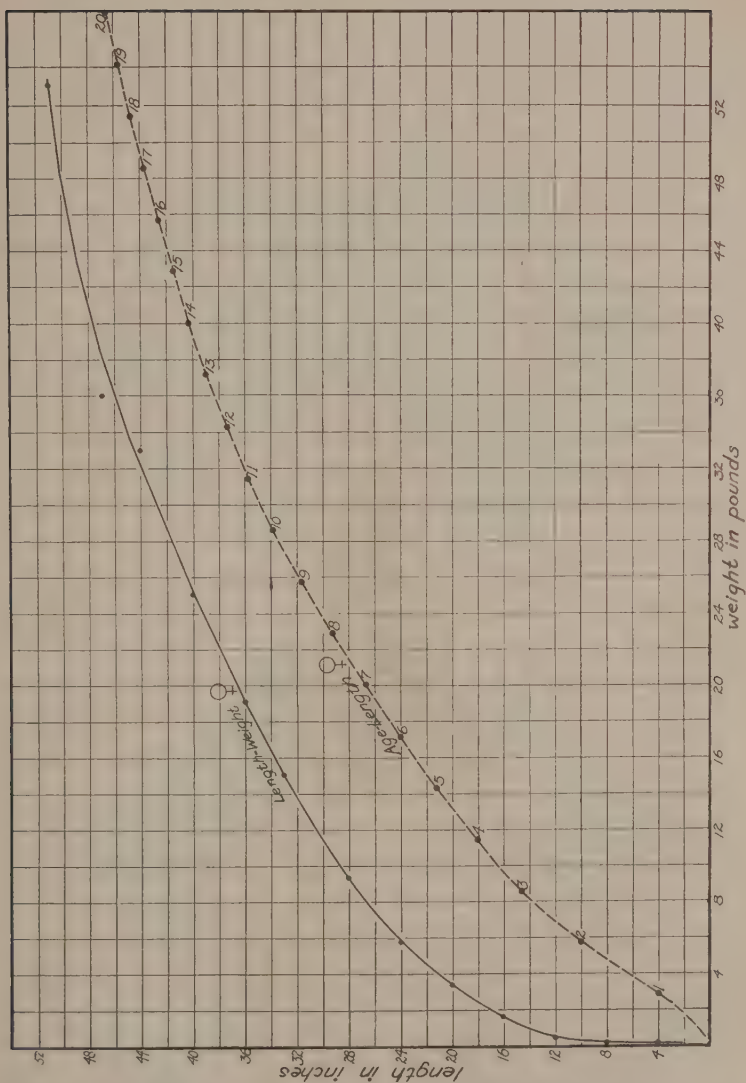


Fig. 38. In the above chart the age-length curve represents the annual increase in length of female striped bass between one and twenty years of age. The length-weight curve represents the proportionate increase in weight with the increase in length of females. To determine the age of your female bass locate its total length in inches on the vertical scale to the left. From this point trace across horizontally until the line intersects the age-length curve. The age of your bass will then be the number directly above on the curve. If only the weight is known then locate the weight of your bass on the horizontal scale at the bottom. Trace up vertically until the line intersects the length-weight curve. Then trace to the right, horizontally, until the line intersects the age-length curve. Read the number directly above on the curve. This will be the age of your fish.

in the curve. It is evident, therefore, that there are a few bass lingering in deep holes which have an excellent record of 25 to 30 years behind them. From a reliable source has come the statement that the record striper from the east coast was well over 100 pounds in weight which would undoubtedly class it as 30 to 35 years or more.

HOW TO AGE YOUR BASS BY THE CHART

In order to age your striped bass by using the chart, all you need know is either the length or weight of the fish. The length is preferred since it is more constant. Assume that your fish is 36 inches long. Locate 36 inches on the vertical scale to the left, then trace across horizontally until the line intersects the age-length curve. Since it intersects at a trifle above 11, the fish is in its twelfth year.

Now assume that the length of this fish was unknown, but its weight was 19 pounds. Locate 19 pounds on the horizontal scale at the bottom, then trace up vertically until the line intersects the length-weight curve. From the point of intersection trace vertically to the right until the line intersects the age-length curve. The result is 11 plus, or the fish is in its twelfth year.

One can expect to use this scale with a fair amount of accuracy. Among bass over 36 inches in length there is a great deal of variation in age-lengths. Below 36 inches the age variations in respect to length are greatly minimized. Because of this condition it can be said that the chart can be used very accurately in age determinations of fish less than 36 inches in length, but, one can expect a certain amount of error in aging bass more than 36 inches. For accurate age determination of very large bass it is requested that the scales, along with the length, weight, sex, date and locality, be sent to the author in care of the Division of Fish and Game, Bureau of Commercial Fisheries, San Francisco.

THE PRESENT STATUS OF THE PISMO CLAM

*Tivela stultorum*¹

By FRANCES N. CLARK

ORIGINAL DISTRIBUTION AND ABUNDANCE

WHEN the first settlers came to California, they found on all the exposed sandy beaches of southern California a great abundance of exceptionally thick shelled clams, which in these later years are known to everyone as Pismo clams. These clams have been taken as far northward as Half Moon Bay, just south of San Francisco, and are reported from this point southward along the coast of southern California and Lower California to Socorro Island. Their exceptionally thick shell fits them for a life in the sand constantly exposed to the heavy beat of the surf and it is only on such open beaches that the Pismo clam thrives.

¹Contribution No. 115 from the California State Fisheries Laboratory, December, 1931.

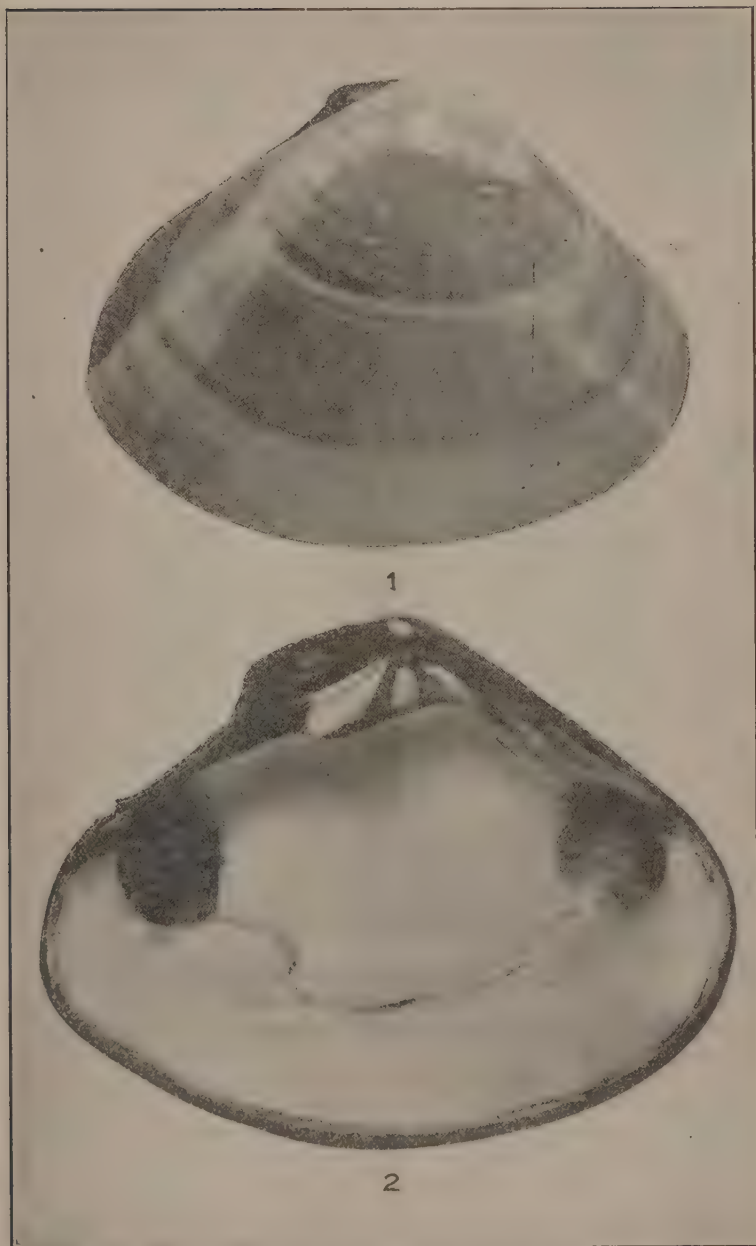


Fig. 39. Pismo clam, *Tivela stultorum*. 1. Exterior view showing three dark rings indicating that the clam was in its fourth year when taken. 2. Interior view. (From Calif. Fish and Game Comm., Fish Bull., no. 4, pl. 6.)

Stories of the abundance of these clams in the early days tax the credulity of the present generation of clammers frequenting these same beaches. At low tide the beaches were reported as "paved" with clams and in various localities, notably Pismo and Long Beach, the farmers are reputed to have plowed the clams out and used them as hog and chicken feed and for fertilizer. This tremendous abundance persisted in some measure at least on Pismo Beach as late as 1919 as is attested by figure 40. In this view of a portion of Pismo Beach at low tide in the fall of 1919, every mound and pit represents a clam. In addition



Fig. 40. Pismo Beach at low tide in 1919. Each mound and pit represents a Pismo clam. (From Calif. Fish and Game Comm., Fish Bull., no. 7, fig. 15.)

other clams which do not show in the picture were present deeper in the sand.

HISTORY OF LEGISLATION

Before 1919, Pismo clams had become scarce on the more southerly beaches, notably Long Beach, and in Monterey Bay to the north. Because of this growing scarcity the first legislation to protect these clams was enacted by California in 1911, when a limit of 200 clams per digger per day and a minimum size limit of 13 inches around the outer edge of the shell was defined. This law remained in operation until 1915, when the bag limit was reduced to 50 clams and the size limit to 12 inches around the outer edge. In the succeeding three

sessions of the Legislature, the laws relating to Pismo clams were changed in each biennium and each new act became more stringent. In 1917 the size limit was changed to $4\frac{3}{4}$ inches in greatest breadth, the bag limit remained at 50 clams, but a closed season was enacted from May 1 to August 31, applicable to District 17, Monterey Bay. In 1919 the size limit was left at $4\frac{3}{4}$ inches and the closed season for Monterey Bay remained unchanged, but the daily bag limit was reduced to 36 clams. In the next legislative year, 1921, the size limit and closed season again remained unchanged, but once more the bag limit was reduced, this time to 15 clams per day.

After 1921 the Pismo clam laws were not changed until 1927, when the minimum size limit was increased to 5 inches in greatest diameter, the bag limit remained at 15 clams and the closed season remained effective. In addition shipment of clams was prohibited and it became unlawful to retain clams in possession if removed from the shell. This last regulation was passed to simplify the enforcement of the size and bag limits. In 1929 all the restrictions of 1927 were unchanged, but in addition a closed area was created known as District 18A and comprising the southern portion of Pismo Beach. In this closed area no clams may be dug during any season of the year. In 1931 the laws were again made more stringent by applying the general angling license law to Pismo clams. All amateur diggers must first secure an angling license costing \$2 per year for residents of California, \$3 for people from other states, and \$5 for aliens. Throughout all these years commercial clam diggers have operated under the commercial fishing license laws. The size limit of 5 inches, the bag limit of 15 clams, the closed season for District 17, and the closed area for District 18A remained unchanged in 1931.

SCIENTIFIC INVESTIGATIONS

During the years when all these laws were passed for the protection of the Pismo clam, the Division of Fish and Game of California has made a scientific study of these clams. The work was inaugurated by Weymouth in 1919 and in 1923 he published the first detailed account of the life history and abundance of this species. Following Weymouth's work further studies of life history and abundance were made by Herrington and published in 1930.

By means of the dark rings on the shell (see figure 39) it is possible to determine the age of individual clams and the results of Weymouth's and Herrington's work indicate that Pismo clams are mature and spawn for the first time at the beginning of their third or fourth year. The present legal size limit of 5 inches is reached between 6 and 10 years with an average of 8 years. The former limit of $4\frac{3}{4}$ inches was attained between 5 and 8 years and the average sized clams were of legal dimension at 6 or 7 years. This means that under protective measures which have been in force since 1917 clams could have spawned from 3 to 4 times before they might be taken from the beach legally. The effectiveness of this size limit is discussed later in this report.

In addition to life history studies, Weymouth inaugurated in 1919 a statistical study of the clam population on Pismo Beach. Each fall since that date a census has been made of the clams to be found in this region. The method consists of digging a trench of standard width

and depth across the intertidal zone and recording the number, age and size of all clams found in this trench. This gives an accurate record of the number of clams of each year class to be found in any season on the beach and makes possible a comparison of these numbers from year to year. The increasing scarcity of the clams as revealed by these censuses has brought about the more and more stringent protective measures which were passed between 1919 and 1931.

STUDIES OF ABUNDANCE

One of the most striking revelations of this statistical study of the Pismo clam has been the great variation in the yearly set of young clams, the result of each season's spawning. In some falls the clams of the year have been exceedingly numerous and in other years so scarce as to indicate that the season's spawning was practically a failure. The largest set that has been recorded occurred in 1919; the four succeeding years were characterized by few young clams; and in the fifth year, 1924, a good set of clams was found. The clams of the 1924 year class were only one-fifth as abundant as those for 1919, but about three times more numerous than the total for the four previous years. After 1924 again four seasons elapsed when each year's set of young clams was very few but in 1929 the set was once more very good. In 1929 the clams of the year were somewhat more plentiful than in 1924 but only one-fourth as abundant as in 1919. The following year, 1930, produced another good set equal to 1924 and again in 1931 young clams resulting from that season's spawning were very numerous. The 1931 set exceeded the 1924, 1929 and 1930 year classes and was almost one-half as great as the 1919 year class.

Weymouth and Herrington, through studies of the cross-section material and through data from the commercial catch, suggested that successful spawnings for the Pismo clam may occur in intervals of 5 to 7 years. The finding of good sets in 1929, 1930 and 1931 furnished further indications of this same time interval between good sets. The set of 1929 occurred five years after the 1924 successful spawning and the set of 1931 seven years later. One difference in these later sets remains, however. The 1919 and 1924 year classes were immediately preceded and followed by poor sets while from 1929 to 1931 three successful years occurred in succession.

Since the 1919 and the 1924 year classes were each followed by poor spawning years, the Pismo clam fishery until 1929 was largely maintained by these two age groups. For this reason the history of these two groups graphically describes the history of the entire population on this beach. Herrington traced the abundance of the 1919 group and found that until these clams reached legal size, the decrease in numbers was not excessive, but after 1924 when about half of this age group was of legal size these clams began to disappear rapidly. By 1926 there were no clams of this year class left on the beach. Thus within three years after the exceptionally abundant year class of 1919 had reached legal size it had been entirely removed from the intertidal zone of Pismo Beach—a very striking commentary on the intensity of clamming in this region.

The history of the 1924 year class is even more tragic. This group of clams was never as abundant as was the 1919 group which may

account in part for its more rapid disappearance. The percentage loss from 1924 to 1925, however, was no greater than the loss during the corresponding year of life for the 1919 class. This loss amounting to about 30 per cent probably resulted from the natural death rate brought about by environmental conditions. Between the fall of 1925 and 1926 the clams of the 1924 year class decreased alarmingly, and by 1927 this group had been so greatly reduced as to be no more numerous than clams of corresponding ages which resulted from poor sets. Before any of the 1924 clams reached legal size in 1930 the entire group had disappeared from the intertidal zone. Although the 1919 year class was taken from the beach within three years after it reached legal size, the 1924 year class did not survive long enough to grow to legal size. Because we have no records of exceptionally unfavorable environmental conditions during the years that the 1924 group was growing to

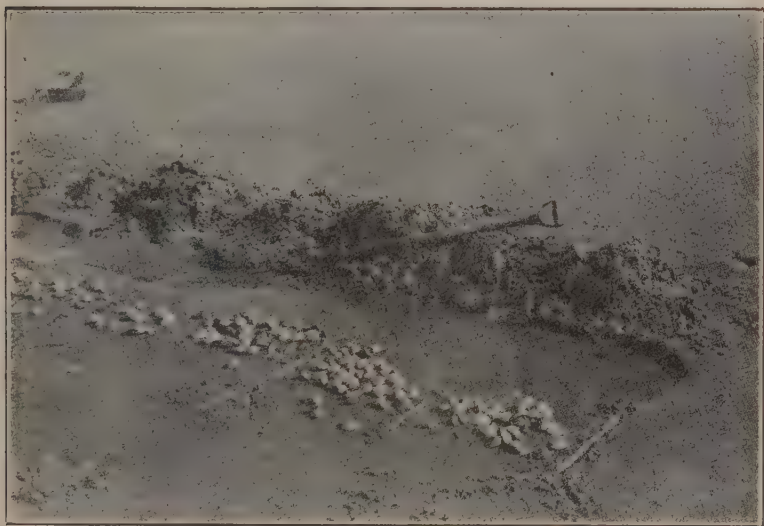


Fig. 41. The results of a cross section made about 1919 to 1922. A trench has been dug and the clams found in each of four meters and a part of a fifth meter are shown. (From Cal. Fish and Game Comm., Fish Bull. no. 7, fig. 14.)

maturity, we must conclude that the rapid decrease in clams of this year class resulted from their being taken by the clammers before they had attained a legal size limit.

The fact that clams are now being removed from Pismo Beach before they are of legal size testifies to the great paucity of clams in this area. Were large clams to be found in the intertidal zone, clammers would not be tempted to encroach more and more on the undersized clams. A comparison of figures 41 and 42 further illustrates the tremendous change in abundance which has been brought about in the past ten years. Figure 41 shows the results of a cross section census made about 1919 to 1920 when clams were fairly abundant. The trench was marked off in meter segments and the clams found in four meters and part from a fifth are shown in the picture. The trench was 16

centimeters in width. Figure 42 is the picture of a census made in 1929. Three meters of the trench have just been dug, the sand has been carefully forced through a screen, and everyone is intently watching for the 3, 4 or possibly 10 clams which may be found in the three meters of trench.

Each year the results of the fall census are more discouraging than the last. In 1931 clams comprising year classes older than 1929, the



Fig. 42. Results of a cross section dug on Pismo Beach in 1929. Three meters of trench have been dug, the sand forced through a screen, and everyone is watching carefully for the three, four or possibly ten clams which may be found in the screen. Photo by R. S. Croker.

first good set since 1924, were almost 50 per cent less numerous than for corresponding year classes in 1930. The total number of clams on the beach increased between 1930 and 1931, but this increase was brought about by the exceptionally good sets of 1929, 1930 and 1931. If these three year classes had a fair chance of survival the future prospects for the Pismo clam might be less dismal but the history of these groups bids fair to be even more tragic than that of the 1924 group.

In figure 43 are shown mortality curves for all year classes since 1918. In order to simplify the presentation, these year classes have been combined into two five-year groups, 1919 to 1923, 1924 to 1928, and contrasted with the 1929-1930 combination. Each of the five-year combinations represents the survival curve of an abundant group and of four sparsely represented groups. The clams found in each fall's set and representing 0 age were considered 100 per cent, and the number of clams in each succeeding year of life were expressed in percentage of the numbers in the 0 group.

For the first five-year combination, 1919-1923, the percentage decrease was not great until after the third year. Between the third and fourth year the curve drops rapidly and this decline continues until the sixth year when there were practically no clams of these year classes left on the beach. Throughout most of their life, the clams of these year classes were protected by a legal size limit of $4\frac{3}{4}$ inches. Thus the clams of each age class reached the legal size between 5 and 8 years.

The rapid decrease in numbers between the third and fourth year suggests that clambers were continually taking clams just under legal size and that any one age group was seriously reduced in numbers before it had attained an authorized size limit. If there had been no poaching of undersized clams, the rapid drop which occurs in the curve between the third and fourth year would not have occurred until the sixth and seventh year. Since the 1919-1923 curve represents an average of five years, we feel justified in concluding that the rapid decrease in numbers of clams just smaller than the legal size limit resulted from man's inroads on the population and not from unfavorable natural conditions. No natural catastrophe could have concentrated on the interval between the third and fourth year. If any one year class had experienced unusually poor environmental conditions between the third and fourth year, these same conditions would have affected the two succeeding year classes between the first and second, and the second and third years, respectively. At the same time the two preceding year classes would have been affected between their fourth and fifth, and fifth and sixth years. Thus in a curve such as presented in figure 5 these fatalities for each year class would have been averaged out and not concentrated between the third and fourth year.

The survival curve for the next five-year group, 1924-1928, shows an even greater mortality rate than for the previous five-year interval. The decrease in clams between the 0 and 1 ages was very little greater than in 1919-1923, but between the first and second, and second and third years the clams disappeared rapidly. The decline from the third to the sixth year was somewhat slower, but as in the previous five-year interval practically no clams of the 1924-1928 year classes remained in the intertidal zone of Pismo Beach after their sixth year. In fact for this second group of five age classes, the relative numbers of clams were so reduced after the fifth year that these year classes played an almost

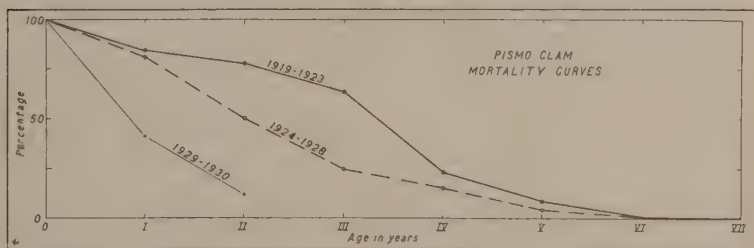


FIG. 43. Mortality curves for all year classes found on Pismo Beach since 1919. The curves represent two five-year and one two-year combinations. 0 age was considered 100 per cent and each succeeding age was expressed in percentage of the 0 group.

negligible role in maintaining the clams on the beach. The clams of the 1924-1928 year classes throughout most of their life were protected by a legal size limit of 5 inches instead of 4½ inches, and yet they were removed from the beach at an earlier age. It is evident that as clams become scarcer the temptation to take undersized clams becomes proportionately greater and each year clambers are removing smaller and smaller clams from the beach.

Because of the pathetic scarcity of clams comprised in the year classes from 1919 to 1928, the survival of the good sets of 1929, 1930 and 1931 is exceedingly important. Nothing can be said as yet for the 1931 year class, but the history for the first two years of 1929 clams and one year for 1930 is shown in figure 43. Between 0 and 1 ages these clams decreased over 50 per cent and the decline from the first to the second year was almost as rapid. Since in former years the normal decrease from 0 to 1 was only about 30 per cent, and since the 1929 and 1930 year classes both experienced a decline of over 50 per cent, the conclusion seems inevitable that the rapid disappearance of the 1929 and 1930 year classes is brought about by man's depredations. The clambers are now taking their toll from clams of all sizes even the smallest not yet two years old.

Since clams spawn for the first time at the beginning of their third or fourth year, probably not more than 50 per cent of the clams of the 1919-1923 year classes spawned more than once before being taken by the clambers. For the clams of the 1924-1928 age groups probably not more than 20 per cent were allowed one spawning before being removed from the beach. If the heavy drain on the 1929 and 1930 year classes continues less than 10 per cent of these groups will be permitted to produce even one lot of spawn.

REASONS FOR THE FAILURE OF PROTECTIVE MEASURES

It is evident from the data presented in figure 43, that the increasing stringency of the laws has not served to protect the clams on Pismo Beach. The reasons for this failure require careful analysis. Two explanations can be offered, either the protective measures enacted have not been adequate to check the depletion of these clams or the laws have not been properly enforced.

We have no measure of the adequacy of the laws, but we do know that it has been impossible to enforce the protective measures. Let it be clearly understood at the outset, however, that this failure to enforce the laws protecting the Pismo clam has not been due to negligence on the part of the enforcement personnel of the Division of Fish and Game. For several years one deputy has devoted his entire time to the Pismo clam work and in addition he has received the aid of other deputies carrying on game protective work in the region. Furthermore, on holidays during the summer one or two additional deputies have been assigned to the Pismo clam patrol. The failure of enforcement has resulted, therefore, not from inefficiency on the part of the Division of Fish and Game but from lack of cooperation of the general public. Part of this lack of cooperation has been due to ignorance. Individuals coming to Pismo Beach from inland regions do not realize the seriousness of the Pismo clam situation and feel that the few undersized clams which they take will have no appreciable effect on the population as a whole. They quite forget the thousands of people who are acting under the same impulse and the resultant tremendous toll taken from the clam population each summer.

On the other hand the residents of San Luis Obispo County should be especially active in their cooperation. The Pismo clam is an invaluable asset to this county because of the tourist diggers which it attracts to the beaches and because of the increase in restaurant trade. At

present Pismo clams may not be legally shipped out of the district, and due to the scarcity of these clams on other beaches, the restaurants of this county are practically the only ones in the entire State which may serve Pismo clams legally. For these reasons it is of great importance for San Luis Obispo County to maintain its supply of Pismo clams.

There is much that private citizens can do to aid law enforcement. Each resident should feel it his personal responsibility to see that all strangers are informed of the laws protecting the clams. But of more importance, although less tangible, is the creation of a community attitude favoring law enforcement. In past years, one of the greatest handicaps to the enforcement of the Pismo clam measures has been the reluctance of the judges to make convictions when violators of these laws were brought up for trial. Time after time the judges have dismissed the cases or suspended sentence. The only result of such a method is that the violator goes out and sins again. Under such conditions the hands of the deputies have been tied and they have been able to do little to decrease the numbers of consistent law violators.

In times past, especially when the 1924 year class was abundant on the beach, the most important factor in the depletion of the clam was the tourist digger. Herrington calculated that on a single low tide as many as 3000 amateur clammers have at times sought for clams in the intertidal zone of Pismo Beach. The resultant number of clams thus removed from the beaches throughout the summer is almost beyond conception, but is clearly proven by the almost complete disappearance of the 1924 year class before it had reached legal size and by the even more rapid mortality rate of the 1929 and 1930 year groups.

As long as a fair number of adult clams remained in deeper water beyond the reach of amateur diggers there was some hope that sufficient spawn would be produced to repopulate the beach. But this adult population is being drawn upon continually by the commercial diggers, and because the later year classes are being taken before they reach adulthood, it is inevitable that the supply of clams in deeper water must decrease. The evidence of this decrease is found in the fact that commercial diggers are yielding more and more to the temptation to take undersized clams and to poach in the closed area where all digging is illegal. The supply of adult clams is now so low that there is grave danger of reducing the spawners to the point where adequate sets can not be supplied. Thus the number of adult clams taken by the commercial diggers is of much greater importance now than they were a few years ago.

POSSIBILITIES FOR THE FUTURE

With this dark picture of the present status of the Pismo clam confronting us: What of the future? If the clams are not to be reduced to a state similar to Long Beach where the occasional specimen found is a rare curiosity, it is imperative that some way be found to protect the 1929, 1930 and 1931 sets until they reach legal size. Our present laws without adequate enforcement will not do this, and if the present laws could be enforced, the clams are now so seriously depleted that they might not furnish sufficient protection to build up the stock. More laws will probably have to be passed. The mildest of these will

be the clarification of the measures relating to the closed area and non-shipment of clams. The law should be amended to prohibit the possession of clams or the possession of any digging apparatus in the closed area and to prohibit the sale of clams outside of the San Luis Obispo and Monterey regions. This would somewhat simplify the enforcement problem. Further protection would be afforded if the sale of clams was prohibited in the entire State. A more drastic measure, but probably the only one which could now augment the numbers of clams, would be the complete closure of the entire beach for an indefinite number of years. Under such a measure permission to reopen the beach should not be granted until the annual census made by the Division of Fish and Game indicated that the population had increased sufficiently to justify such a procedure, and this justification should be decided by disinterested experts in population studies.

But these added restrictions will be of little value unless the laws can be enforced, and the ability to enforce these laws depends chiefly on the residents of San Luis Obispo County. Within the past few months citizens of Pismo and neighboring towns have taken the preliminary steps to aid in the protection of the clams by creating an atmosphere favoring such protection. If this constructive work can be continued the outlook is much more promising. In fact enforcement officials can do nothing further without such support and the future of the Pismo clam is dependent on the actions of local residents. But may the warning be sounded that the efforts expended by the people of this region to protect their clams must be a united one and must be maintained over a long period of years.

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CALIFORNIA FISH AND GAME

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Vol. 18

APRIL, 1932

No. 2

MEETING OF THE FISH AND GAME COMMISSION

At the meeting of the Fish and Game Commissioners which was presided over by President J. Dale Gentry and at which Earl B. Gilmore and I. Zellerbach were present, held in San Francisco on January 28, 1932, the following resolution was adopted relative to rodent control in California:

Resolved, That the Fish and Game Commission has confidence in the U. S. Biological Survey and the State Department of Agriculture and endorses their continued supervision and regulation of predatory animal and rodent control work, but urges these agencies to increase their efforts to prevent unauthorized and careless use of poisons.

Resolved, That the Fish and Game Commission further urges that the use of poison be avoided when other effective methods are available and urges the continuance of studies for the development of control methods which will not be a hazard to humans and to desirable wild life.

Because of the lack of a settled policy and the general misunderstanding that has surrounded rodent control work in California, this resolution came at a very happy time. It is to be hoped that as a result of this action that future cooperation between the Bureau of Biological Survey, the State Department of Agriculture and the Division of Fish and Game will proceed in a regular and orderly fashion.

SUGGESTED SEASON ON WATERFOWL

In order that the sportsmen of California may have an early understanding with regard to the open season on waterfowl during the season of 1932, the Fish and Game Commissioners at their regular meeting held early in March made certain definite recommendations to the Honorable Arthur M. Hyde, Secretary of Agriculture, with regard to the waterfowl situation in California. The contents of the letter forwarded to Mr. Hyde are herewith set forth in full.

"As the result of a careful study of waterfowl conditions in California, the Fish and Game Commission of this State recommends to you the changing of the Migratory Waterfowl regulations to provide for California an open season during the entire months of November and December, 1932.

"It is further recommended that the bag limit for ducks, except wood ducks, be fixed at fifteen and that the bag limit for all geese, including the brant, be fixed at four.

"It is further recommended, and strongly urged, that the possession limits be the same as the bag limits in this State. In California it is entirely practical to make daily shipments of legal game, and it is impossible to enforce a daily bag limit when a larger possession limit is legal.

"It is further recommended that the present distinction between species which gives complete protection to Ross and cackling geese be removed, as the protection is unnecessary in this State, and the enforcement is wholly impractical.

"It is further recommended that due cognizance be taken of the special conditions which maintain in this State, and that the regulations affecting this zone be established in accordance with the requirements of the zone, irrespective of unrelated conditions which may exist in the East and Middle West.

"The Fish and Game Commission of California further recommends to you the selection of an alternate member for each principal selected for membership in your recently reorganized Advisory Committee. The selection of such an alternate would insure a proper representation of all sections of the country, even though pressure of personal business might prevent the attendance of the principal.

"Assuring you of the wish of the Fish and Game Commission of this State to assist you in the preservation of our migratory waterfowl, I am, (Signed) John L. Farley, Executive Officer."

The recommendations contained in the letter from John L. Farley, executive officer of the Division of Fish and Game, to the Secretary of Agriculture, contain in so far as possible all of those opinions which would appear most equitable to the majority of the sportsmen of the State. It is extremely difficult to please all shooters, but from the commendation that has been given the commissioners as a result of their resolution, it would seem that the recommendations contained in the above letter are as near perfect as it is possible to produce.

H. L. BETTEN RESIGNS

H. L. Betten of Alameda, member of the State Game Refuge and Shooting Grounds Advisory Committee of the Bureau of Fish and Game, tendered his resignation as a member of the Advisory Committee to the State Fish and Game Commission at its meeting held on March 2, in San Francisco.

The resignation was accepted. A delegation of the Associated Sportsmen were present and asked that they be given an opportunity of making suggestions as to a successor for Mr. Betten. The request was granted and the Sportsmen Association will present a list of names of those they believe suited for the position.

OPIE L. WARNER, NEW PUBLICIST

Opie L. Warner, San Francisco newspaperman, has been appointed publicist for the Division of Fish and Game, taking over the duties of the office March 1.

Warner succeeds Earl Soto, who for the past two years has occupied the position, and who placed his resignation before the State Fish and Game Commissioners in February.

For more than 20 years Warner has been on the editorial staffs of the *San Francisco Call* and *The Examiner*, having served with the latter paper some five years. Prior to coming to San Francisco he was engaged in newspaper work in San Bernardino, where, besides doing general editorial work, he owned and edited at various times weekly and daily papers.

The new publicist is an ardent outdoor fan, has spent much time in hunting and fishing, and with his experience in this line coupled with his newspaper experience will be able to chronicle the doings of the Division of Fish and Game in a manner that will keep the vast number of hunters and fishermen informed of the work that is being done to stock the streams and hunting grounds of California.

A CORRECTION

In the interest of scientific accuracy I wish to correct an error which appeared in an article written by me for the July issue of CALIFORNIA FISH AND GAME, entitled "Some Notes on the Birds and Animals of the Los Banos Duck Refuge, With Special Reference to Predatory Species." On page 276, in commenting upon the reversal in the killdeer of the usual marital duties of the sexes, I cited an article by Dr. Gayle Pickwell, who has made a special study of this species. In quoting this article I attributed to it more than it actually states, thereby creating the impression that it asserted that the female is more aggressive than the male and that the male constructs the nest. In reality, the evidence presented by Dr. Pickwell indicates only that the male is more solicitous than the female in the process of incubation, as Dr. Pickwell has been good enough to point out to me. My own observations on the greater activity of the female in driving away intruding killdeers may be regarded as new, then, while the question as to which sex constructs the nest remains open to further investigation.—E. L. Sumner, Jr.

REVISED MAILING LIST

With the October, 1931, number of CALIFORNIA FISH AND GAME, an effort was made to weed out those individuals who were receiving the quarterly and yet who had no interest in its contents. For that purpose, a slip was attached to the front cover asking those interested in continuing their subscriptions to forward the same to the San Francisco office.

As a result of this action, the present mailing list is found to contain approximately 7000 names; slightly less than 2000 were removed from the mailing list. In some instances this has been due to faulty mailing addresses and not to a lack of interest in the quarterly.

In order that no interested readers may be overlooked, it is requested that those desiring to be placed upon the mailing list indicate their desire by a letter in writing to the editor.

COMMERCIAL FISHERY NOTES

Alaska has developed a food fish reduction situation similar to that which has been bothering us in California for a number of years.

About the only difference between the two is that in California it is the sardine, while in Alaska it is the herring which causes the difficulty.

In Alaska the herring packers are permitted to use in reduction plants the herring which are not suitable for salting, but the way this works out in practice is that the reduction of herring into oil and meal is the main business and the salting a side issue. A great industry, with millions invested, has been built up and now the investigations of the U. S. Bureau of Fisheries show that the herring supply in southern Alaska is being depleted by overfishing.* The people of Alaska who would conserve their fisheries are asking each session of Congress to pass a law to prohibit the reduction of food fish in Alaska. At each session of Congress the bill fails of passage, the arguments against it being: It would destroy an industry which represents millions of invested capital and employs many men in the capacity of fishermen and reduction plant operators. It is also contended that there is little demand in late years for herring as food, and to close the reduction plants would not increase the output of herring for food. How remarkably like our California sardine situation is this herring controversy in Alaska!

If the reduction industry of Alaska runs true to form it will object to and defeat legislation which would reduce the intensity of fishing, designed to prevent the exhaustion of the herring supply.

We, in California, have been asked: "Why do you care about what happens to the fish after they are caught? Just limit the catch and let the plants do what they please with the fish." This is good advice, provided the fisheries regulatory body has the power to regulate the fishing; but if it is left to Congress or legislatures to pass the fishing regulations, no reduction industry, with millions invested and looking for quick profits, is likely to be put out of business or seriously curtailed to conserve the natural resource represented in the herring or sardine supply.—N. B. S.

According to the annual report of the Biological Board of Canada, an investigation of the pilchard, or sardine, and the herring is being carried on jointly by the Biological Board and the Provincial Fisheries Department in British Columbia. The pilchard investigation was started about three years ago. Samples of the catch have been collected and analyzed as to length, weights and sex, with the object of detecting the signs of depletion. A study is being made of the specific characters of the pilchard, the object being, it is stated, to determine the migrations of the schools and determine the relationship between the British Columbia pilchard and California sardine. Studies are also being made to determine age from the otoliths, as the scales are not satisfactory. They are also collecting material for the study of the pilchard's food throughout the year. Their program, it can be seen, follows very closely the sardine program which is being carried out by the California Division of Fish and Game.

The herring of British Columbia is being investigated along the same lines. In addition, an attempt will be made to each year inspect

* Fluctuation in the supply of herring (*Clupea pallasii*) in southeastern Alaska. By George A. Rounsefell, U. S. Bur. of Fish. Bull. No. 2, 1931, 41 pp., 26 figs., 14 tables.

the spawning areas and collect data on which to base predictions of the future supply of herring.—N. B. S.

Under the new striped bass law it is legal for commercial fishermen to market the striped bass which are accidentally caught in the nets while they are fishing for shad between March 15 and May 1. There were not many shad running prior to March 15 and there was very little, if any, profit in fishing shad alone, but when the date arrived on which bass could be legally taken in the shad nets, fishing at once became profitable. Large numbers of bass were sent to the markets and soon there was an oversupply and the price to fishermen declined until, in less than two weeks, the price had reached 4 cents a pound—the lowest price ever paid for bass in the history of the fishery. As a matter of fact, the fishermen could not get even the 4 cents, as the dealers refused to take any more.

This glut of the market adds more complications to an already difficult situation. Striped bass are continuing to increase in abundance and the river is alive with them at this time (March 25). The net fishermen are prohibited from taking them until March 15, when the market is soon glutted and there is no outlet for the bass accidentally caught during the shad fishing operations. Most of the bass are dead when they are taken from the gill net, and it seems there is nothing the fishermen can do but throw them back, even if they are dead. To thus waste fish is a technical violation of the law also, as there is a statute which prohibits the waste of fish. The new law, which permits commercial hook-and-line fishing in all parts of the State where striped bass are found, apparently permits a larger commercial catch than the old law.—N. B. S.

DIVISION ACTIVITIES

BUREAU OF FINANCE

This department has taken over the handling of fish packers' tax and fines, thereby entailing extra work. It has been found necessary to install a new system of accounts, and one was provided whereby much time was saved and duplication avoided.

All delinquent fish packers' taxes have been satisfactorily settled, with the exception of one packer.

Owing to there being a lull, as usually follows the end of the year and the beginning of another, license income has fallen off. However, with the approach of the fishing season there is expected a big rush for the necessary permits.

The Los Angeles office has caught up with all the work. County clerks are responding in a splendid manner with their license returns, displaying an excellent spirit of cooperation. Such difficulties that have arisen have been made so by the slowness of subagents.

BUREAU OF GAME REFUGES

Water condition on all refuges are reported as being good, a contrast with previous quarterly reports. The many rainy days has caused delays on development work planned at many of the refuges.

With water increasing at the refuges, many ducks and geese are observed frequenting the refuge areas.

The purchase of 1100 acres adjoining the Imperial Valley Refuge was announced by the Commission at the March meeting in Los Angeles. This, it is believed, will cause a lessening of complaint by farmers of that section about ducks damaging their crops.

Mountain lions killed during the months of December, January and February totaled 108. The total slain during 1931 was 293, one less than the preceding year. February marked the largest kill of lions reported for a single month since 1912. The number of big cats taken out of circulation by the state lion hunters being 55, six more than any month since 1912.

Good progress is reported in the San Diego Quail Experimental area. This district is being freed of predatory animals under direction of an experienced trapper.

The refuge crew is completing its work in the southern end of the State and preparing for a trip northward.

BUREAU OF FISH CULTURE

The heavy storms of the present winter, ending the protracted spell of drought, brought joy to those who have seen the streams of this State dwindle to nothing. With the heaviest rain and snowfall in years a plentiful supply of water for the lakes and streams is assured for the present year.

However, the rain and snow, though badly needed and greatly appreciated, also brought its share of hard work to the hatcheries. Precautions to protect the plants from the sudden rise of streams, demanded long hours of hard work of the hatchery forces. Snow had to be cleared in those high up in the mountains, roads had to be opened, and in some instances distribution of eggs was made difficult by the bad conditions of the roads.

The members of the various staffs met the situation and with the exception of the Snow Creek Hatchery, which reports the loss of some 25,000 rainbow trout, but small damage was done.

All the hatcheries were busy preparing for the eggs distribution from the main hatcheries. Quotas were received in fine shape, and the hatching of the eggs exceptionally good, in spite of the unusual weather conditions.

The planting and distribution of trout for the season of 1931 was completed in the latter part of December, and over 33,000,000 of this species of fish were shipped or planted during the year.

The heaviest planting of Chinook salmon made in ten years was finished during February when over seven million were freed in the Klamath River, and nearly four million in the Sacramento River. All these salmon were hatched at the Mount Shasta Hatchery.

The first experiment in gathering salmon eggs from the Klamath River, taking them to the Mount Shasta plant and planting the hatch in the Klamath was pronounced a great success.

BUREAU OF GAME FARMS

With the ending of the heavy rainy season and the approach of spring the outlook is better than for several seasons for propagation work on both game farms.

With the coming of March egg gathering was commenced and preparations completed for hatching eggs of the pheasants, quail, grouse and turkeys. The brooders are ready and everything is in shape to fill the orders for both eggs and young birds.

This year in addition to furnishing eggs and twelve-weeks old birds, arrangements have been made to send out 30-day-old chicks to responsible people, who will see to their care and feeding until they are of an age proper for liberation. The 30-day old chicks will have passed the danger stage and will thrive in properly constructed quarters and with the proper care.

Inspection trip over the State, taking our Superintendent as far south as Imperial Valley, disclosed the fact that game birds released in the past are thriving, and he was more than pleased with the survey.

Bakersfield and Fresno sportsmen are completing their plans for 48 standard pens to accommodate 2000 pheasants, which they will maintain under our supervision.

All our breeding stock is in splendid condition and a banner year is indicated.

BUREAU OF HYDRAULICS

This Bureau was busy with cleaning up oil from ocean waters, occasioned by the breaking of pipe lines at various points along the coast. One of the most serious was in San Pedro harbor when a line break dumped some 350 barrels of oil into the bay waters. However, efficient equipment soon cleared the bay.

At Rodeo the Standard Oil line broke and released about 500 barrels into the bay, but by damming the small creek into which the oil had gone, little, if any, got out into the open waters of the bay.

The Benbow Power Company has apparently been able to install a proper fish ladder at their power dam, as the steel head are getting up stream in a satisfactory manner.

The Folsom fishway has been completed, meeting a long required need.

The disposal systems of southern California oil companies withstood the rigorous storms of the season in excellent manner.

Inspection was made of the Pacific Gas and Electric work in Amador County, also the Cosumnes dam and fishway.

This Bureau is cooperating with the State Highway Commission in installing bridges over creeks along the new Coast Line Highway between Monterey and San Luis Obispo.

BUREAU OF FISH RESCUE AND RECLAMATION

The radical change of water conditions between the winter of 1931 and this year caused the work of this Bureau during March and February to be somewhat different. Last season, with low water, it was necessary to remove and transplant over seventy thousand fish; this year the total amounted to only 1589.

Flooding of the State streams during the heavy storms of the winter entailed much work, to see fish were not left in areas that would be left high and dry when the streams subsided to a normal level.

The year ending December 31, this Bureau accounted for the rescue of 7,038,972, while deputy wardens rescued 816,893 fish.

From a survey over the State it is evident but comparatively few fish have been lost during the year. Fish rescued were placed in permanent water, close to the point of rescue.

BUREAU OF PATROL

The heavy snowfall in the high Sierra during the storms that featured the past winter presented a problem to the patrol that called for prompt action and understanding. With the mountains covered by high drifts, deer and quail were facing starvation, their feed being cut off entirely in many localities. Our wardens, with the splendid cooperation of sportsmen and landowners, met the situation and relieved the dangers by carrying feed to birds and animals. As a consequence the latest survey show the deer to be in good condition, and reports indicate that but few were lost.

The bulk of the work was in Modoc, El Dorado, Tuolumne, Lassen, Plumas and Siskiyou counties.

The arrests for the past three months show a falling off and a consequent reduction of fines.

Arrests for December, January and February totaled 467, as against 588 a year ago. Fines were \$10,070, a decrease of \$7,828 from last year.

Since July 1, 1931, to February 29, there has been 1441 arrests, and fines collected amounted to \$38,215, which is over \$20,000 less than a like period to February 28, 1931. This condition is due to the fact that there has been less hunting and fishing than in former years, due to economic conditions.

The wardens also assisted in fish rescue work where the swollen streams were spreading fish over areas that would be dry soon after the heavy rains had ceased.

The Reo truck and crew were sent from Owens Valley to assist in the salmon planting from the Mount Shasta Hatchery.

BUREAU OF COMMERCIAL FISHERIES

With the closing of the sardine season, February 15, came the end of one of the poorest seasons of several years. At Monterey the delivery of sardines was over 44,000 less than the previous season. Poor prices for canned sardines, meal, and oil—lowest for years—is responsible for the lessened delivery. There were plenty of sardines but no market, and it is estimated the Monterey carry-over will amount to 200,000 cases.

Monterey fishermen were granted permission to bring in 3000 tons as an emergency measure by the Division of Fish and Game. They asked for a permit for 5000 tons, their petition being backed by the mayors and chambers of commerce of Monterey and Pacific Grove, who pointed out that it was a splendid economic move, furnishing work for many men who otherwise would be out of employment, and with boats to maintain. However, owing to inclement weather the fishermen only brought in 510 tons.

Serious trouble was threatened between tuna fishermen and packers at San Pedro, and at Monterey with the sardine interests and fishermen. But it appears that permanent breaks have been averted.

Heavy seas during the recent storms caused damage to canners and fishermen around Monterey Bay amounting to some \$60,000.

The *Albacore* has been busy patrolling from Monterey to Point Reyes, keeping fishermen beyond the three-mile limit, and also observing that the floating reduction plant ship kept out of State waters. A close check has been kept by this department on the output of this floating reduction plant, and while figures indicate they will not make a profit this season, on account of low prices, it does show that in normal times such ships could be maintained at enormous profits, and would prove a menace in reducing the supply of sardines along the California coast.

The *Bluefin* made inspection trips for oil seepage, lobster traps and fish smugglers along the lower coast from San Diego to the Santa Cruz Islands. Off Anacapa Island the *Bluefin* rescued the fishing boat *Clover*, which was in distress.

The *Bluefin*, during the early part of the year, was overhauled to some extent, and radio equipped. Thus fitted out, on February 4, it left for a cruise to Magdalena Bay and along the coast of Lower California. Many hauls were made for sardine eggs and larvae, and seining for young sardines in sheltered waters. A detailed account will be available in a short time on the results of the cruise.

E. C. Scofield was transferred from the Hopkins Marine station to the laboratory, where for some time he will furnish information on sardine spawning and development.

This bureau is working in harmony with Stanford University on oceanographic work, and interesting developments will be presented at the end of the survey.

Much interest has been displayed in our Fish Bulletin. We now have 2000 names for copies from those interested in the Bulletin generally and 3000 applications from those who are interested in a single or few of the subjects covered.

Paul Bonnot, of this department, with the State Board of Health and U. S. representatives, has completed a preliminary survey of oyster lands along the California coast, and working out plans to insure sanitary handling of oysters and preventing the marketing of those from contaminated beds.

Merrill Brown, Junior Fisheries Researcher, made a trip to plan for installation at Mount Shasta Hatchery of wire screen and trap to count salmon going to sea. The proper racks have been installed and ready when the young salmon start to migrate.

In northern waters there have been but few violations of the fish laws and, as down in southern waters, those who broke the laws were quickly arrested and punished.

VOLUNTEER DEPUTIES

Much valuable work was done by the voluntary deputies during the heavy snow storms which cut off the feed for thousands of quail. Plenty of proper feed was taken to points where the quail were virtually on the point of starvation. In some instances the feed had to be taken by men on snow shoes.

The volunteer deputies are devoting much time to the supervision of quail sanctuaries. The results derived from these sanctuaries can be surmised by the reports received on 300 questionnaires sent to those landowners who have set aside a part of their land for the propagation of quail. All replies but very few indicate a goodly increase of birds.

The vounteer deputies, who now number 400 in the State, have in addition to looking after quail sanctuaries and relief work for quail during the year, rendered valuable service to the deputy wardens.

The annual report shows they have checked 49,364 licenses; hunting, fishing and deer tags; assisted and made 413 arrests, from which fines amounting to \$10,378 were collected, and have killed, by trapping and shooting, 7068 predatory birds and animals.

The predatory bird and mammal prize contest closed March 1st, and the response to the contest was most pleasing. Prize winners were announced in the April Service Bulletin.

BUREAU OF EDUCATION AND RESEARCH

James Moffitt during February took the second annual census of black sea brant in California. He made a personal count of the birds at Tomales, Humboldt and Morro bays. Through the kind cooperation of the Museum of Vertebrate Zoology and the members of the San Diego Museum of Natural History, counts were also taken at Bodega, Drakes and San Diego bays. A detailed report of this census will appear in a future issue of this magazine.

E. L. Sumner, Jr., is working on the area in San Mateo County where experiments are being conducted on quail environment and habits. Pens have been constructed and the enclosures planted to food suitable for the birds. The quail are under constant observation and from what is learned of food conditions, life history, natural enemies and habits, it is hoped that valuable information of a practical nature will be secured to the end that the division will be in a position to put the theory in practice on other areas to benefit quail conditions and ultimately replenish their abundance.

Extensive lecture programs have been carried on in the schools of various counties. It is hoped that through this concentrated effort it will induce the County Boards of Education to introduce nature study in the curriculum.

REPORTS

STATEMENT OF INCOME

For the Period July 1, 1931, to December 31, 1931, of the Eighty-third Fiscal Year

License sales	Detail	Total
Departmental income:		
Angling licenses, 1931.....	\$312,728 00	
Angling licenses, 1932.....	64 00	
Commercial hunting club licenses, 1931-32.....	1,375 00	
Commercial hunting club operators' licenses, 1931-32.....	345 00	
Deer tags, 1931.....	115,136 00	
Fish breeders' licenses, 1931.....	85 00	
Fish importers' licenses, 1931.....	15 00	
Game breeders' licenses, 1931.....	130 00	
Game breeders' licenses, 1932.....	15 00	
Hunting licenses, 1931.....	250,363 40	
Hunting licenses, 1932.....	19 50	
Kelp licenses, 1931.....	10 00	
Market fishermen's licenses, 1931-32.....	26,420 00	
Trapping licenses, 1931-32.....	1,908 00	
Wholesale fish packers' and shell fish dealers licenses, 1931-32.....	1,070 00	
Total license sales.....		\$709,683 90
Other income:		
Contributions from importers.....	\$25 00	
Court fines.....	36,346 87	
Fish packers' tax.....	38,718 61	
Fish tag sales.....	1,962 84	
Game tag sales.....	117 87	
Interest on bank balances.....	3,548 97	
Kelp tax.....	49 88	
Miscellaneous sales.....	568 25	
Total other income.....		\$81,338 29
Total departmental income.....		\$791,022 19
Income for the State University Fund:		
Kelp tax.....		\$24 92

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to December 31, 1931, of the Eighty-third Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau administration:					
Executive	\$4,200 00				\$4,200 00
Clerical and office	10,985 81	\$648 67	\$155 58	\$171 26	11,961 32
Printing		6,979 05			6,979 05
Automobiles		126 43	171 11		297 54
Traveling			1,696 97		1,696 97
Postage			3,025 73		3,025 73
Telephone and telegraph			2,375 28		2,375 28
Freight, cartage and express			1,592 15		1,592 15
Rent			7,654 31		7,654 31
Accident and death claims			1,737 68		1,737 68
Accounting pro rata	2,250 00				2,250 00
Legal	3,300 00		386 65	75 55	3,762 20
Publicity			68 86		68 86
Total bureau administration	\$20,735 81	\$7,754 15	\$18,864 32	\$246 81	\$47,601 09
Bureau education and research:					
Chief and assistants	\$3,000 00				\$3,000 00
Clerical and office	1,219 95	\$109 97	\$107 38		1,437 30
Traveling			3,088 55		3,088 55
Telephone and telegraph			13 03		13 03
Freight, cartage and express			79		79
Photographer	720 00		77 54	\$846 00	1,643 54
Librarian	1,020 00	12 78	50 24	84 10	1,167 12
Research	5,250 00	133 88		28 00	5,411 88
Blue printing			12 66		12 66
Publicity			398 43		398 43
Exhibits			8 25		8 25
Lecturer	1,890 00				1,890 00
Total bureau education and research	\$13,099 95	\$256 63	\$3,756 87	\$958 10	\$18,071 55
Bureau patrol and law enforcement:					
Chief and assistants	\$5,520 00				\$5,520 00
Clerical and office	1,620 32	\$34 91	\$8 68	\$11 47	1,675 38
Automobiles		3,928 42	2,072 41	613 76	6,614 59
Traveling			65,557 36		65,557 36
Postage			224 35		224 35
Telephone and telegraph			943 88		943 88
Freight, cartage and express			24 59		24 59
Rent			248 15		248 15
Heat, light and power			6 82		6 82
Captains and deputies	104,554 31	769 09	272 46	286 65	105,882 51
Launches		638 04	572 29		1,210 33
Fish planting	3,767 72	539 81	205 00		4,512 53
Volunteer deputies	360 00				360 00
Premiums on bonds			561 97		561 97
Temporary help	24 00				24 00
Cooks	975 00				975 00
Total bureau patrol and law enforcement	\$116,821 35	\$5,910 27	\$70,697 96	\$911 88	\$194,341 46
Bureau commercial fisheries:					
Chief and assistants	\$7,980 00			\$41 00	\$8,021 00
Clerical and office	5,310 00	\$206 75	\$77 67	3 00	5,597 42
Automobiles		351 97	151 99		503 96
Traveling			11,151 91		11,151 91
Postage			3 52		3 52
Telephone and telegraph			320 44		320 44
Freight, cartage and express			384 21		384 21
Rent			616 42		616 42
Heat, light and power			140 72		140 72
Research	4,543 09	13 16		53 54	4,609 79
Captains and deputies	8,450 00	128 18	36 57	10 00	8,624 75
Launches	6,305 00	1,864 94	1,361 75	184 20	9,715 89
Laboratory	16,065 00	388 50	697 46	150 86	17,301 82
Blue printing			2 52		2 52
Hydro-biological survey—Monterey Bay			750 00		750 00
Statistics		271 10	758 35	42 15	1,071 00
Fish cannery research			7,500 00		7,500 00
Fish cannery inspectors—seasonal	8,611 61				8,611 61
Total bureau commercial fisheries	\$57,264 70	\$3,224 60	\$23,953 53	\$484 75	\$84,927 58

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to December 31, 1931, of the Eighty-third Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau fish culture:					
Chief and assistants	\$4,120 00				\$4,120 00
Clerical and office	2,079 67	\$156 16	\$22 85	\$85 05	2,343 73
Automobiles		2,743 76	1,163 05		3,906 81
Traveling			5,463 11		5,463 11
Postage			59 57		59 57
Telephone and telegraph			576 33		576 33
Freight, cartage and express			429 49		429 49
Rent			859 00		859 00
Heat, light and power			577 88		577 88
Hatcheries	50,023 38	29,052 07	873 25	1,234 89	87,183 59
Special field investigations	5,358 66	173 03		7 25	5,538 94
Fish cars	1,770 00	206 46	878 53	2 95	2,857 94
Blue printing			\$4 95		34 95
Cooperative research	598 50	36 49	306 67	80 55	1,022 21
Fish hatchery assistant—seasonal	14,866 78				14,866 78
Total bureau fish culture	\$84,816 99	\$32,367 97	\$11,244 68	\$1,410 69	\$129,840 33
Bureau hydraulics:					
Chief and assistants	\$4,170 00		\$22 32		\$4,192 32
Clerical and office		\$18 44	23 97		42 41
Automobiles		204 84	152 06		356 90
Traveling			1,097 80		1,097 80
Postage			1 00		1 00
Telephone and telegraph			5 40		5 40
Cooperative research	1,500 00				1,500 00
Total bureau hydraulics	\$5,670 00	\$223 28	\$1,302 55		\$7,195 83
Bureau game propagation:					
Superintendents	\$1,650 00				\$1,650 00
Clerical and office	40 00				40 00
Automobiles		\$255 67	\$83 55		339 22
Traveling			1,001 93		1,001 93
Postage			5 00		5 00
Telephone and telegraph			143 51		143 51
Freight, cartage and express			6 07		6 07
Heat, light and power			451 55		451 55
Maintenance		4,914 19	532 36	\$1,709 13	7,165 68
Assistants	7,196 15				7,196 15
Total bureau game propagation	\$8,886 15	\$5,169 86	\$2,223 97	\$1,709 13	\$17,989 11
Bureau fish rescue:					
Chief and assistants	\$2,590 00		\$176 72		\$2,766 72
Traveling			1,394 52		1,394 52
Rent			110 00		110 00
Total bureau fish rescue	\$2,590 00		\$1,681 24		\$4,271 24
Bureau game refuge:					
Chief and assistants	\$4,249 98				\$4,249 98
Clerical and office	960 00	\$22 76			982 76
Automobiles		447 96	\$150 49		598 45
Traveling			2,122 47		2,122 47
Postage			1 00		1 00
Telephone and telegraph			16 65		16 65
Freight, cartage and express			50		50
Lion hunters and trappers	4,019 50				4,019 50
Refuge posting		118 66	252 60	\$863 04	1,234 30
Predatory animal control			3,120 00		3,120 00
Temporary help	6,094 11				6,094 11
Refuge maintenance	2,730 00	2,813 02	940 79	54 00	6,537 81
Total bureau game refuge	\$18,053 59	\$3,402 40	\$6,604 50	\$917 04	\$28,977 53
License commissions					\$25,094 10

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to December 31, 1931, of the Eighty-third Fiscal Year—Continued

Function	Total
Construction, improvements and equipment:	
Permanent repairs on Brookdale Hatchery.....	\$761 30
Improvements at Lake Almanor Hatchery.....	1,380 68
Telephone and power line from Chester to Lake Almanor Fish Hatchery.....	2,400 00
Filter at Big Creek Hatchery.....	141 85
Construction of dams on Cherry Creek.....	1,000 00
Completion of egg collecting racks at Chester.....	497 38
Construction of rearing ponds and a temporary house for an attendant, Hat Creek, Inyo County.....	1,238 58
Tank and egg collecting station at Huntington Lake.....	1,920 17
Improvements, and equipment for filter at Kaweah Hatchery.....	316 98
Repairs and improvements at Mt. Shasta Hatchery.....	875 37
Permanent improvements on Snow Creek Hatchery.....	1,233 12
Total construction, improvements and equipment.....	\$11,765 43
Purchase of game refuges.....	127,650 00
State Fair and other exhibits.....	4,801 06
Prior year expense—eighty-second fiscal year only.....	14,998 86
Grand total proprietary group.....	\$717,525 17

SEIZURES OF FISH AND GAME

October, November, December, 1931

Fish:	
Abalones.....	1,036
Abalones, pounds.....	270
Bass, striped.....	60
Bass, striped, pounds.....	400
Clams.....	1,857
Crabs.....	17
Cockles.....	312
Lobsters.....	575
Lobsters, pounds.....	3,048
Mussels, pounds.....	150
Salmon, pounds.....	895
Spotfin, croaker, pounds.....	56
Skipjack, pounds.....	215
Trout, steelhead.....	17
Spear (fish).....	4
Nets.....	1
Miscellaneous fish.....	9
Game:	
Deer.....	209
Deer meat, pounds.....	1,358
Deer hides.....	3
Doves, pigeons.....	42
Ducks, geese, mudhens.....	646
Non-game birds.....	119
Rabbits.....	7
Shorebirds.....	44
Swans.....	6
Skins (animals).....	37
Traps (animal).....	13
Turkeys, wild.....	5
Wood ducks.....	10
Bird nets.....	4

FISH CASES

October, November, December, 1931

	Number arrests	Fines paid	Jail sentences (days)
Angling License Act; violations of.....	50	\$742 50	36
Abalones; undersized; overlimit.....	37	725 00	43
Bass—			
Black; closed season.....	1	20 00	-----
Striped; small.....	9	220 00	-----
Clams; overlimit; undersized.....	38	595 00	175
Cockles; small.....	2	5 00	-----
Crabs; closed season; female crabs.....	14	200 00	100
Commercial fishing license act; violations of.....	16	80 00	-----
Destroying fish.....	1	200 00	-----
Fishing too near dam.....	6	55 00	25
Illegal fishing apparatus.....	18	182 50	36
Lobsters; small.....	33	855 00	107
Mussels; overlimit.....	1	25 00	-----
Miscellaneous fish.....	1	10 00	-----
Night fishing.....	9	-----	10
Nets, seines; illegal.....	11	365 00	150
Pollution of streams.....	1	50 00	-----
Salmon; overlimit.....	6	165 00	10
Trout; closed season.....	2	25 00	-----
Totals.....	256	\$4,520 00	692

GAME CASES

October, November, December, 1931

	Number arrests	Fines paid	Jail sentences (days)
Commercial Gun Club License Act.....	5	\$25 00	-----
Deer; closed season; killing fawns, does, spike bucks.....	96	3,640 00	595
Deer tags; failure to attach tags; hunting without tags.....	36	1,150 00	25
Doves; closed season; overlimit.....	8	200 00	-----
Ducks, geese, mudhens; overlimit.....	11	825 00	-----
Hunting License Act; violations of.....	78	1,402 50	244
Hunting in refuge.....	54	891 00	-----
Nets (bird); illegal.....	6	100 00	-----
Night hunting.....	49	705 00	300
Non-game birds; killing of.....	38	660 00	-----
Pigeons; closed season.....	4	135 00	-----
Pheasant; closed season.....	9	675 00	125
Quail; closed season.....	24	1,395 00	5
Rabbits; closed season.....	2	25 00	-----
Shorebirds; closed season.....	25	435 00	10
Squirrel (gray); closed season.....	9	200 00	-----
Swan; closed season.....	8	220 00	-----
Shooting from motor boat; auto.....	7	87 50	-----
Trespassing.....	15	115 00	-----
Turkeys (wild); killing of.....	1	-----	125
Trapping License Act; violation of.....	7	85 00	160
Woodducks; killing of.....	5	30 00	-----
Totals.....	497	\$13,001 00	1,589

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1931

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey
Albacore							22,385		10,918
Anchovies							1,504	271	35,310
Barbauda									11,072
Bonito									720
Carp					1,508	24			
Catfish					87,458	37,362			
Cutts Cod	100,004	5,752		1,156			83,708	2,935	47,655
Flounders	37,804	6,240			6		19,322	405	
Grayfish	19,145						49,459	2,137	355
Hake	420						6,806		
Halibut	69,682						3,192	609	2,102
Hardhead					9,999				
Herring	173		146,142				54,440		
Kingfish							126	1,839	50,809
Mackerel							1,636	2,264	116,014
Mackerel Horse									130,187
Mackerel Spanish									
Mullet									
Perch	13,177		9,348				8,920	162	5,523
Pike					287	18			
Pompano								10	287
Rock Bass									
Rockfish	91,869	5,917					120,960	141,453	332,599
Sablefish	257,621	1,042					6,961	111,783	7,912
Salmon	26,330			725	276	222			
Sardines	44,067	4,810					22,222	249	230
Sculpin							30,735,768	500	62,759,216
Sea Bass							20	175	
Sea Bass Black							4,574	207	25
Sea Bass White			1,353						5,021
Sheepshead									
Skates									
Skipjack	16,002						26,736	1,825	1,262

Smelt.....	62,621	967	8,884				10,885	28,977	78,160
Sole.....	1,195,490	43,738					743,570	23,021	4,076
Spittail.....									
Striped Bass.....						749			
Sting Ray.....			407			18,312			
Suckers.....									
Swordfish.....						87			
Tomcod.....									
Tuna—Bluefin.....	1,940						406		
Tuna—Yellowfin.....									
Turbot.....									
Whitebait.....		136					969		
Whitefish.....			130				1,490		1,685
Yellowtail.....									
Miscellaneous.....	15,833	130							
Total fish.....	1,952,178	68,732	166,414	20,414	118,282	171,922	31,928,672	318,836	63,602,033
Crustaceans:									
Crabs.....									
Ecrevisse.....	14,476	326					354,826	42,448	
Shrimps.....									
Spiny Lobsters.....			223,855			6,440	46,871		1,726
Mollusks:									
Abalone.....									641,600
Clams—Cockle.....	212	230							
Clams—Mixed.....		416	29,254						
Clams—Pismo.....	12,381								
Clams—Sofsbell.....								965	8,287
Cuttiefish.....	302	124	19,868			5,324	13,932		
Mussels.....	400						126		1,552
Oysters—Eastern.....									
Oysters—Native.....			50,732				47,155		
Squid.....	25,385	234					28,654		187,700
Miscellaneous:									
Terrapins.....		648							
Totals.....	1,995,334	70,476	490,357	20,414	118,282	183,686	32,620,036	322,249	64,442,888

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

- * 186 6-12 dozen.
- * 13 7-12 dozen.
- * 23,109 5-12 dozen.
- * 102 dozen.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1931—Continued

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	San Luis Obispo, Santa Barbara, Ventura.....	Los Angeles.....	Orange.....	San Diego, Imperial.....	Total.....	Fish from south of the International Boundary brought into California via San Pedro.....	Fish from south of the International Boundary brought into California via San Diego.....	Total fish from south of the International Boundary brought into California.....
Albacore.....		2,706			13,624			
Anchovies.....		888	270		58,853			
Barracuda.....		357,036	401	53,315	423,738	129,584	39,224	168,808
Bonito.....	69	647,041	913	8,636	698,110	59,470		59,470
Carp.....		1,260			2,732			
Catfish.....		24			125,976			
Cuttus Cod.....		214			240,078			
Flounders.....	14	37,882	9	24,211	64,014	25	3,345	3,370
Grayfish.....	1,037		25,094		159,320			
Hake.....		66,336	4,623	5,757	7,226	547	1,336	1,883
Halibut.....	77,986				230,287			
Hardhead.....				15,320	9,599			
Herring.....					216,075			
Kingfish.....		52,578	308	84	105,734			
Mackerel.....		5,479,921	40,689	39,852	5,681,301			
Mackerel—Horse.....	1,035	115,269	160		245,616			
Mackerel—Spanish.....						1,880	585	2,465
Mullet.....		2,794	2,794	3,261	6,055	370	342	712
Perch.....	174	11,555	73		48,932			
Pike.....					305			
Pompano.....	551				848		455	455
Rock Bass.....	1,800	38,506	7,746	29,339	77,391	4,398	1,054	5,452
Rockfish.....	10,732	465,410	4,462	130,213	1,303,615	455	1,109	1,594
Sablefish.....		7,471			392,760			
Salmon.....					77,553			
Sardines.....		1,598	45		73,291			
Sardines.....		36,201,859		3,029	130,411,362			
Sculpin.....		12,208		3,807	17,746			
Sea Bass—Black.....	210	27,253	6,853	22,075	56,416	40,107	18,165	58,272
Sea Bass—White.....	689	262,096	236	7,086	281,282	4,389	3,235	7,624
Sheepshead.....	9,870	39,170	687	13,025	62,752			
Skates.....		6,299	420		52,544			
Skipjack.....		17,294		1,965	19,259	1,101,273	931,123	2,032,395

Smelt	5,080	70,521	41,465	3,367	310,957	88	9	97
Sole.....	53,371	17,311	20	261	2,080,888	-----	-----	-----
Spittail	-----	-----	-----	-----	2,899	-----	-----	-----
Striped Bass	-----	-----	-----	-----	169,917	-----	-----	-----
Sting Ray	-----	287	-----	-----	437	-----	-----	-----
Suckers	-----	-----	-----	-----	87	-----	-----	-----
Swordfish.....	-----	85,756	438	31,488	117,682	-----	-----	-----
Tomcod.....	-----	-----	-----	-----	2,346	-----	-----	-----
Tuna—Bluefin.....	-----	6,593	-----	-----	6,593	-----	-----	-----
Tuna—Yellowfin.....	-----	18,427	-----	1,490	19,917	-----	-----	-----
Turbot.....	-----	-----	-----	-----	1,119	-----	3,098,049	5,349,288
Whitebait.....	-----	24,218	6	-----	3,441	-----	-----	-----
Whitefish.....	300	148,110	2,499	15,470	39,694	4,597	520	5,117
Yellowtail.....	45	153,022	42	72,179	223,088	128,000	77,749	205,749
Miscellaneous.....	-----	-----	-----	2,130	174,165	33,693	108,811	137,504
Total fish	873,382	44,377,730	141,799	487,290	144,227,674	3,760,115	4,280,111	8,040,226
Crustaceans:	-----	-----	-----	-----	-----	-----	-----	-----
Crabs.....	-----	450	-----	-----	561,926	-----	-----	-----
Ecrivisse.....	-----	-----	-----	-----	278,892	-----	-----	-----
Shrimps.....	-----	-----	-----	-----	282,571	-----	-----	-----
Spiny Lobsters.....	35,038	133,868	10,355	103,310	-----	2,756	345,343	348,099
Mollusks:	-----	-----	-----	-----	-----	-----	-----	-----
Abalones.....	23,896	-----	-----	-----	665,496	-----	-----	-----
Clams—Cockle.....	-----	10,286	-----	-----	39,982	-----	-----	-----
Clams—Mixed.....	-----	672	-----	-----	13,469	-----	-----	-----
Clams—Pismo.....	16,163	-----	-----	-----	25,415	-----	-----	-----
Clams—Softshell.....	-----	-----	-----	-----	39,650	-----	-----	-----
Cuttlefish.....	-----	98	39	-----	1,815	-----	-----	-----
Mussels.....	-----	-----	-----	-----	400	-----	-----	-----
Oysters—Eastern.....	-----	-----	-----	-----	97,887	-----	-----	-----
Oysters—Native.....	-----	-----	-----	-----	54,273	-----	-----	-----
Squid.....	70	-----	-----	-----	187,770	-----	-----	-----
Miscellaneous:	-----	-----	-----	-----	-----	-----	-----	-----
Terrapins.....	-----	-----	-----	-----	648	-----	-----	-----
Totals.....	948,549	44,522,704	152,193	590,600	146,477,768	3,762,871	4,625,454	8,388,925

* 2 1-12 dozen.

* 23,413 7-12 dozen.

ABSTRACT

CALIFORNIA SPORTING FISH AND GAME LAWS

VALID UNTIL 90 DAYS AFTER CLOSE OF 1933 LEGISLATURE

1931 OPEN AND CLOSED SEASONS 1932

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

GAME	DISTRICTS	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	BAG AND POSSESSION LIMITS, ETC.
DEER	1½										15			No Does, Fawns or Spike Bucks No Forked Horned Deer in Dist. 14 No sale of Venison or Deer Skins
	2-2½-3									14				Two Bucks per Season except in 1½ where limit is one See Notes 6-9-10-12
	4-1½-4-4½-4¾-5 2-4-2B									15	15	15	15	15 per day. 30 per week. No limit in District 4 No protection in 4½
Rabbits—Cottontail and Brush	ALL EXCEPT 4½											15	15	See Note 7
Bear, Fur Animals	ALL											15		Predatory animals suggested in districts 2½-3-4-4½
Ducks, Geese,	FEDERAL LAW													15 Ducks, 30 in Possession; 4 Geese, 8 in Possession; 20 Snipe, 25 Mud Hens, No Ross Snipe or Cackling Geese
Jack Snipe, Mud Hens	STATE LAW	15												25 Ducks, 25 Snipe, 25 Mud Hens, 50 Per Week Goose Limit See Note 4. See Notes 9-10-11-12-13
Quail—Valley, Desert and Mountain	ALL EXCEPT 1½											15	15	Valley and Desert 15 per day. 30 per week Mountain 10 per day. 20 per week
Dove	ALL EXCEPT 1½													
	4-4½-4¾													Federal Season Opens Nov September 1
														15 per day 30 per week

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Pigeon, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Wild Pheasant, Partridge, or Wild Turkey.

FISH	DISTRICTS	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	BAG AND POSSESSION LIMITS, ETC.
Steelhead and all Trout (except Golden), Whitefish	1-1½-1½-2-3-4-4-4-15 Klamath River, Lake Almanor													Bag limit for taking and possession, 25 trout or 10 pounds and one trout. No Sparring for other restrictions See Notes 12-15-16-20 21-22-28-29 31-33 On this Canal
	2½		23			30								
	23-24-25					10								
	Truckee River					15								
Unlawful to take trout in waters closed by Governor's proclamation	See Note 22													
	1½ Winter Klamath River													5 Trout regardless of weight
	Russian, Navarro, Napa and Lake Dist 2 Tidewater Dist. 2-3-15													3 Trout regardless of weight
Golden Trout	ALL													20 per day. None under 5 inches Not more than 10 lbs. and one
BLACK BASS	ALL EXCEPT 4¾ CLEAR LAKE IN LAKE CO.													15 per day No Closed Season in 1½ Clear Lake 10 per day
														No Black Bass under 9 ins. No sale Hook and line only
Sunfish	ALL													25 per day
Sacramento Perch and Crappie	ALL EXCEPT CLEAR LAKE													25 per day
	CLEAR LAKE													10 per day
Striped Bass	1-3-12A													None under 12 inches, 5 per day. None to be taken from Salton Sea. See Note 19
Crabs	ALL EXCEPT 1½-6-7-8-9							30						Season Districts 1-½-7-8-9 August 31, December 10 See Note 24, None under 7 inches. No Female Only for food. Must be brought to shore alive in whole Any License Required. See Note 27
Abalones	ALL	14				16								None under 5 inches. No shipment. 15 per day Any License Required. District 18a Closed No Sale of Meat. None under 10 lbs or over 15 inches
Pismo Clams	17													See Note 24
Spiny Lobster	ALL											15		
GRUNION	ALL													

Salmon and Shad May Be Taken as Noted in Paragraphs 19-23. No open season on Sturgeon (possession prohibited).

NOTES

IT IS ALWAYS UNLAWFUL

- To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, within districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or the Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in the Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge or San Leandro Bay Refuge.
- To hunt birds or mammals excepting predators without a hunting license.
- To possess any bird net or to net, trap or to hold protected game or birds or any kind, their nests or eggs except under written permit from the Commission.
- To take or possess more than 8 geese per day or 50 per week; or more than 8 honkers or sea brant per day or 24 per week.
- To take or kill non-game birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnet, white pelican, shag, and in districts 1, 2, 3, 4 and 4½, blackbirds.

- To hunt deer without a deer tag license. To fail to attach to the horns of deer immediately on killing, property filled out license tag or at the same time to send duplicate tag to the Division. To carry a deer into a closed district without having license tag countersigned, or to have untagged deer in possession. To fail to retain in possession during open season and for ten days after the skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than one dog to the hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.
- To trap for profit bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox, beaver, muskrat, or to kill these animals during the closed season, except when destroying property. To interfere with the traps of licensed trappers. To use saw tooth or spike jawed traps for taking fur bearers.
- To use any animal other than a dog to stalk wild birds.
- To shoot game from a power boat, sailboat, auto, airplane; or to hunt waterfowl from a scull boat in districts 8, 9, except on Wednesdays and Sundays, or at any time in district 12 or Napa River south of Edgerly Island, or to use a

